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ABSTRACT

Intended to assist building trades instructors, this course outline to a prevocational building trades program for junior and senior high school students covers four occupational areas: carpentry, masonry, plumbing, and electricity. Specific notes to the administrator and teacher and the course goals precede the four occupational units. Each unit contains occupational information, instructional analysis, behavioral objectives, and a bibliography specific to the occupational area indicated. Additional information on apprenticeship opportunities, an equipment list, and a sample project developed in a Building Trades I class are also included in this course outline. (BH)

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BUILDING TRADES 1

COURSE OUTLINE

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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INTRODUCTION

Recently, many prevocational course materials have been developed for the construction cluster. Most of these programs are exploratory in nature and provide a wide range of experiences for students interested in all aspects of the construction cluster. The World of Construction (IACP) and the American Industries Project are two examples of curriculum projects which serve this purpose.

Building Trades I has been designed as a continuation of these prevocational programs and is concerned with a sound vocational preparatory building trades program for junior and senior students. Students should have made a tentative occupational choice before entering this course. In reality, occupational choices need to be systematically reevaluated during the entire duration of the course.

It serves as a pre-apprenticeship program. The intent is not to flood the market with semiskilled workers. The real intent is to provide a seedbed where young men and women may grow and develop in the skills, information and attitudes necessary for qualifying as superior candidates and be transplanted into apprenticeship programs or entry-level employment. Just as high school athletes are competitively recruited for college athletic programs, building trades programs should be upgraded so that their students will be competitively recruited for apprenticeship programs. Each instructor has the responsibility to meet the needs of his students and to instigate the transition from the traditional "cabinetmaking" program into a more comprehensive building trades cluster program.

The purpose of this outline is to assist building trades instructors in improving instruction throughout the State of Arizona. This publication should serve as an outline and must be supplemented by each instructor's methods and materials. Any information in this outline that does not concur with the instructor's unique situation should be modified to meet his needs.

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TABLE OF CONTENTS

Page

INTRODUCTION i

ACKNOWLEDGMENTS ii

TO THE ADMINISTRATOR 1

TO THE TEACHER 7

COURSE GOALS 11

UNITS

CARPENTRY
CEMENT MASONS
Occupational Information 15
Instructional Analysis and Behavioral Objectives 17
Bibliography 20
CARPENTERS
Occupational Information 23
Instructional Analysis and Behavioral Objectives 25
Bibliography 32

MASONARY
BRICKLAYERS
Occupational Information 43
Instructional Analysis and Behavioral Objectives 44
Bibliography 48

PLUMBING
PLUMBERS AND PIPE FITTERS
Occupational Information 53
Instructional Analysis and Behavioral Objectives 55
Bibliography 62
WELDERS
Occupational Information 65
Instructional Analysis and Behavioral Objectives 67
Bibliography 70

ELECTRICITY
ELECTRICIANS
Occupational Information 77
Instructional Analysis and Behavioral Objectives 79
Bibliography 83

APPRENTICESHIP OPPORTUNITIES 87

EQUIPMENT LIST 95

PROJECT 105

TO THE ADMINISTRATOR

While most of their classmates sit at desks and study textbooks in heated, well-lighted school rooms, some 200 high school students in Fairfax County, Virginia, learn to put up with dark skies, rain, wind, and freezing weather when they study. These students are learning skilled trades—carpentry, masonry, air-conditioning and heating, and electrical work—by constructing a large, split-level house to be sold for about $60,000.

In the business world, such enterprises seldom can afford to wait on the weather. Since the school program is designed to teach youth how to make a living in construction, it requires them to get the job done despite the elements, Bernard Blanke, house project coordinator, said recently.

"This is completely different from a sterile classroom situation," he said. "When it's 30 degrees outside, it's real. That's life in the building trades. We can't heat up the outdoors, and we can't dry the land out when it rains."

Around Blanke, students sank ankle deep in mud as they hauled lumber to the building site. Others installed electrical wiring, their ungloved hands exposed to a sharp wind sweeping through the house framework. Nevertheless, the program has great appeal for high school students. Since it began a year ago last fall, the school system's enrollments in building trades classes have doubled.

In years past, Fairfax County did all building trades training in regular vocational shop classes. Both Blanke and Louis Godla, county director of vocational education, now speak disparagingly of this method. It limited neophyte masons, for example, to the use of used brick or block held together with a soft mixture of sand and lime that contained no cement. Once a wall was up it had to come down—a process which was repeated many times. Godla says students disliked this artificial approach after they gained the basic skills. Usually it resulted in a negative attitude and in students laying less and less brick.

Today, with building trades taught in a more realistic manner, student interest is high enough to tolerate brief, introductory study in school shops before an assignment in construction of the house. Student home builders spend half a day in English, math, and other regular classes at their own high school and then are bussed to the house to work for the rest of the day.

Legislation Spurred Growth

All over the United States students are building or remodeling houses under school supervision. Ohio schools were among the first to adopt this approach; a few of them have held carpentry classes on construction sites for at least 20 years. However, much of the growth in school construction programs across the country has taken place since the sixties, when Federal legislation to update vocational education made grants available to build area vocational education facilities. Large area vocational schools now dot our landscape and have the student bodies, equipment, and faculty which help make undertakings like house construction feasible.

Today, nearly all high school carpentry classes in Ohio are doing home construction, and a few schools in the State are using such projects to teach other building trades as well. In Texas, where the State requires a wide range of training for all building trades classes, more

than 140 house construction programs are in full swing. Tennessee has about 80 student programs, some serving only carpentry students and others drawing on the talents of all vocational students, whether they are taking drafting, horticulture, or heating and air-conditioning.

In Pennsylvania, a local school district and a nonprofit, church-sponsored organization are teamed together for a double purpose—to train retarded youth in the building trades and to turn out housing for low-income families. Some schools in California, Florida, and a number of other states also tie their building trades instruction to homebuilding.

When schools get into the building business, they do not compete with tradesmen and businessmen in the construction field, educators say. School production of housing is low and slow because the schools' primary aim is teaching.

It takes considerable time to learn a building trade, Blanke pointed out. In his opinion, it is not until a worker hammers home something like his 15,000th nail that he achieves the balanced, coordinated arm action of a skilled carpenter. Before a student reaches this mark, he is likely to place many nails badly. "If a job is not done right in our classes, we do it again," Blanke said. This policy applies to all aspects of construction from placement of roof trusses to the proper use of tools and other equipment.

The four bedroom, three bathroom house in Fairfax County, now under roof and scheduled for completion and sale this spring, "probably is overbuilt," Blanke admits. He thinks whoever purchases this home will get a good buy. Among features not standard in nearby housing will be a full spectrum of electrical wiring, including garden lights and an intercommunications system. Again, the reason is rooted in the fact that the purpose of the project is to teach trade skills. Because most students will have worked in only one house before they graduate, the school system is trying to give them the widest possible experience.

"We are dealing with day-to-day problems in construction that never showed up in the classroom," Blanke said. "To solve them, teachers learn new techniques from other teachers on the job, from our advisory committee members, and from the kids. This is what education is supposed to be—collective learning.

"Too often classroom teaching consists only of information that has been regurgitated for the past ten years. That's why some of our students get turned off in the classroom and play hookey from school if no work is going on here. This house is the only reason they come to school."

Like many such programs, the one in Virginia takes in juniors and seniors and turns out motivated workers who readily find employment, according to Blanke. "While they are far from being fully trained craftsmen, they are productive and earn money for their employers from their first day on the job," he said. "Those with better skills will move up quickly."

Many Problems Persist

Oliver K. Schaer, the State of Washington's director of trade, industrial, and technical education, has commented that the purpose of such programs "is not to flood the building trades, but to get better qualified applicants for existing apprenticeable jobs." A few schools in Washington for a number of years have run student carpentry programs on real construction sites. However, a pilot program in the building and construction trades is now

underway in half a dozen school districts "to learn if this is a desirable direction for us to go in vocational education elsewhere in the State," Schaer explained. Currently, he is somewhat concerned about whether such projects will offer enough in-depth instruction to turn out well-qualified youngsters, and he finds there are difficulties in using one instructor, even though versatile, to teach several trades.

Blanke does not make light of the problems to be overcome. Fortunately, the two instructors who are assigned to the home construction and who teach about 30 students at one time, have long and diversified trades experience.

Running the project is ten times harder than anything he ever experienced in industry, Blanke says. Coordination "is a nightmare." Students from all secondary schools in the sixteenth largest school system in the Nation can enter the program. Careful scheduling is required to gather them together, teach them, and return them to home schools. Work must be done in proper sequence, with carpenters arriving after masons and the like, and care must be taken to avoid having too many students at the site at one time.

Adding to these problems is absenteeism caused by special school activities or vacations. Then, too, the amount of work students will do cannot be predicted with accuracy. Even when completed, a job may have to be torn down and a fresh start made. But Blanke believes the program has survived these problems and now is firmly established.

To date, Fairfax students have built a small residence on a public site in addition to the split-level house. By the time the house is done, plans are to have two more lots ready for house construction. All vocational services are involved in this program. Drafting students work on house plans, home economics classes decide on kitchen layouts and house color schemes, horticulture students plan and plant the grounds, business students type purchase orders and distributive education students are to market the house.

Financing for lot purchases, building materials, and the like is provided by the Fairfax County Vocational Education Foundation, Inc., a nonprofit corporation set up to advance the interests of vocational education in the county and to give the vocational program a direct tie to the community. The foundation solicits tax-deductible donations and draws upon the expertise outside the school system on behalf of vocational education. In addition to school personnel, the foundation's board of directors includes representatives of the local board of realtors; bankers', bar, and builders' associations; Chamber of Commerce; and the engineering, architectural, and accounting professions.

New Concept in Funding

County vocational education director Godla feels strongly that the nonprofit foundation idea is far more important to vocational education than the student building program alone.

"With this approach we could revolutionize the funding of vocational education for off school site programs," he said. "It offers people in the community a way to give money, materials, and their own talents to vocational education, and it gives us a revolving fund which will continue to finance these programs. The foundation budget will not terminate every July—we know the money will stay in vocational education."

Godla said the foundation board of directors, who are unpaid, are active and valuable participants in this program. For example, an architect works with drafting classes on house design. The technical director of the local builders' association keeps a sharp eye on the

house construction. Lawyers, a public accountant, and businessmen helped set up the foundation's legal and financial machinery.

In about four years, the foundation may have accumulated a substantial amount of capital from private contributions and profits on house sales, Godla said. The funds will be used not only for house building projects but also to start other training programs. Among the possibilities is a small retail store to give students purchasing, warehousing, and merchandising experience.

In many respects, the Virginia program was modelled on one that began in 1968 at the Area Vocational-Technical School in Bethlehem, Pennsylvania, which enrolls tenth through twelfth grade students from three school districts. But the Pennsylvania school did not go the foundation route for financing. It obtained all its initial funds from the school district.

"We presented the house construction proposal at a school board meeting and got approval the same night," Joseph Risbon, director of the school, recalled. "All we were asked to do was to keep the houses we built representative of the community."

The Bethlehem school began building houses on land left over from a large parcel purchased in one district for the construction of new schools. At this site, now divided into 13 lots, the sixth and seventh student-built houses are going up. In addition, students are building a 1000-square-foot elementary school library. To run the program, a coordinator and seven teachers were brought in from the building trades.

Eleventh and twelfth grade students do the home construction after taking a year of shop classes at the area school. In all three years, students spend half a day on vocational pursuits and the other half in regular classes. Although building trades students do most of the work, the house projects also use the talents of those who are studying architectural drafting, horticulture, and commercial art (for advertising brochures).

The number of students doing home construction has jumped from 40 in the first year of the program to 200, Risbon said. But not all are working on school-sponsored projects; about 30 seniors are in a cooperative program and work for private employers from noon to 3 p.m. "Trades people are so eager to get our students that sometimes we have a hard time keeping them," Risbon said. For those who decide to go to work full time, the school offers classes three nights a week in which they can earn a high school diploma.

Homes built by students are all-electric and have radiant ceiling heat which is controlled in each room, stereophonic sound and intercommunication systems, rheostatic light controls, and central air conditioning. They have full basements, patios, fireplaces, insulated window glass, two-car garages, and many other features which place them in a quality housing class, Risbon said.

The first house, completed in 1968, sold for $38,100. Since then one house has been built a year and prices have risen, with the house completed last year selling for $50,100 in a sealed bid. The school system has averaged a profit per house of about $6,250.

Mentally Handicapped Trained

In Smock, Pennsylvania, on the opposite side of the State, there is a unique program which is training mentally handicapped young men on construction projects. The emphasis is on developing good work habits and attitudes as much as on preparing the students for work in the building trades.

The program began several years ago with renovation of buildings to be used for the school district's special education classes. Young men in the tenth through twelfth grades who were enrolled in these classes converted an old bus garage into a woodworking shop, an auto body shop, and a classroom. Later they renovated a five-room house to be used for home management classes for young women in special education.

During construction, the students began to learn what the world of work is like and to develop some skills that would be useful to them in many different types of jobs. Alvin Sheetz, director of special education for the school district, said, "Most important, they gained confidence in themselves," Sheetz pointed out. "Lack of confidence is a crippling and common deficiency among slow learners. All their lives they have been made to feel that they cannot learn—that they are stupid and useless."

Once these projects were finished, the school district began looking about for similar work. About two years ago, it signed an agreement with a nonprofit organization, Concerned of Pennsylvania, which was set up to produce low-cost housing and is sponsored by churches, the Pennsylvania Department of Community Affairs, and the Appalachian Regional Commission. Under the Concerned-school district agreement, students in special education classes build or rehabilitate houses while Concerned acts as the financial agent. Both parties refer to the agreement as a "happy marriage because it is built on mutual dependency." Before their relationship, special education classes had run out of meaningful work, and Concerned of Pennsylvania was having trouble keeping the cost of the housing it produced within the reach of low-income families.

To date, students have renovated a four-bedroom house which sold for $9,500. They now are putting up a new, prefabricated house which will sell for about $15,500. The 20 students in the construction program stay at the job site all day, but spend half their time in a trailer where they study regular school subjects. Construction tasks that require reading and mathematics act as a spur to classroom studies, Sheetz has found. "These students are eager to make a living," he said, "and they know this may be their last chance to learn how."

Apparently, they are learning. All eight of last year's graduates are employed—two in the building trades, and the rest in a variety of other jobs. Their pay ranges from $2.60 to $4.80 an hour. "In years past, we trained special education students for the welfare rolls," Sheetz said. "Now, with housing as a vehicle and with future employment our chief concern, we are teaching them to make a living."*

*Condensed from "From the Ground Up," *Manpower* February 1973

TO THE TEACHER

Building Trades I Outline contains four major units in Carpentry, Masonry, Plumbing and Electrical. Minor units in Concrete and Welding are also included. Each unit includes: (1) Arizona Occupational Information, (2) Instructional Analysis including a unitized Task Inventory Analysis and Information Topics, (3) Behavioral Objectives, (4) Bibliography including books, films, filmstrips, transparencies and teaching aids.

Each unit of instruction is based on an Instructional Analysis. The Instructional Analysis is based on Duty and Task statements and Information Topics. A duty is a large segment of work performed by an individual. It is composed of several related tasks. Action words ending in "ing" are used to designate duties. There are several major duties in each unit of this outline.

A task is the basic unit of work activity which forms a significant part of a duty. The instructor should demonstrate to the class how to perform a single task. Each task has several steps necessary for completion. The task is the basic "doing" operation in the course.

Information topics are an essential part of every course. At least one-fifth of the time each week should be set aside for covering the "knowing" aspects of the course content. Transparencies, films and filmstrips may help the instructor present many of the information topics. Resource people can also be used to good advantage. Information sheets, assignment sheets, and tests and oral evaluation should be important aspects of the course and, last but not least, a good test should be chosen for the course to facilitate cognitive learning.

Behavioral objectives have been derived from the Instructional Analysis of each unit. Since the objectives provide direction for the teaching-learning process, it is important for the instructor and the students to have a common understanding of the intent of each objective. Reading of the Objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements. Instructors should feel free to add objectives which will customize the content to the needs of his students and the community.

Now, in initiating a building trades program for your school, the following suggestions are paraphrased from an article by Mr. Jack Down in the June 1974 issue of *School Shop:*

1. **Don't bite off too much.** Plan construction so that students learn those skills which you have targeted, and subcontract everything else.

2. **Don't let the house building consume all learning time.** Make time for other learning experiences at least once a week. One cannot take a young student and teach him to build a building if he is not willing to build character. A young person today faces a complex world. It is not enough to teach skills alone. Industry wants workers who are loyal and display a wholesome competitive spirit. Proper attitudes, honesty,

integrity and other desirable personal/social values can be most effectively taught in a VICA (Vocational Industrial Club of America) program. Any instructor who really wants to "get it all together" will integrate a VICA program into his building Trades I course. VICA is a tried and proven successful tool of instruction available to every building trades instructor.

3. **Form an advisory committee.** This should be a requirement for every vocational program. Select representatives from your community to help expedite the program. Have a local builder, a city representative from the building department, a local real-estate person, a local contractor of building supplies, and others serve on the committee. A booklet entitled *Advisory Committee* is available from the Arizona State Division of Vocational Education to help you set up a functional Advisory Committee.

4. **Select a good text.** Have it the first day of class. Wagner's *Modern Carpentry*, published by Goodheart-Willcox Co., is a popular choice, but there are several other good texts you can use.

5. **Establish close contact with local builders,** besides having a builder on your committee. People from the industry are usually glad to drop by and give advice. The contact will also provide an opportunity for people to take a look at prospective employees.

6. **Establish good supply channels.** Have a standard method of ordering and line up your suppliers beforehand. In a large city, have bids for suppliers or be ready to justify your choices, or you may be hearing the word "favoritism" bandied about. In a small town you may not have a choice.

7. **Get insured.** Decide what insurance you need for the project and have it the first day of class . . . not next spring.

8. **Observe all safety standards.** Don't forget the new OSHA standards.

9. **Obtain the necessary tools.** Although many school woodshops require heavy machinery, on-the-job construction projects require mostly small power and hand tools.

10. **Provide quick and easy tool access.** This usually means having all tools in one place, with someone to keep track of them.

11. **Appoint a weekly foreman** for both construction and tools. The construction foreman should help with planning and ordering.

12. **Plan for next year.** If this will be a continuing program, get a head start in the spring. Check needed tools, get permits, acquire land, pick a house plan, secure subcontractors, and arrange financing (after all, some

$20,000 to $30,000 will be tied up in the bu ding before it can be sold). It may be self-defeating to use current funds while expecting the money to be replaced before the end of the fiscal year.

13. **Have an open house.** Have an open house while the house is still open. The open house at the end of the year is also a good idea.

14. **Use the media.** A program like this is newsworthy, year after year. Besides a boost for the teacher and the school, a couple of complimentary news articles are a great reinforcement for the students, many of whom normally have a tough time getting any recognition.

15. **Involve other school classes** if you can. Those in drafting can make the plans. Use the services of the vocational agriculture class to plan and execute the landscaping. Have the home economics group decorate the interior. Ask the business class to keep records for the construction project.

16. **Provide lasting recognition.** Cast the names of the participants in bronze and set the plate in the garage or basement floor.

17. **Guarantee the construction.** Any student-built house should have a clear set of reasonable guarantees, since the inspectors may overlook a few errors.

COURSE GOALS

A two year building trades program is intended to develop through school shop experiences, construction site experiences, and related instruction, the necessary skills, knowledge and attitudes for successful entry into apprenticeship programs or entry-level employment in the building trades. Emphasis is on each student to master hand manipulative skills, and to develop skill in the proper care and use of tools and equipment. Related instruction covers applied mathematics, blueprint reading and estimating, and technical information related to the trades. Each student progresses at his own rate as demonstrated by his ability and application. It is inherent in this type of instruction that a great deal of emphasis is put on individual instruction, demonstration, and application.

A desirable approach to implement this vocational program would provide opportunities for either (1) actual home construction by the class or (2) cooperative educational opportunities on construction sites or around the school grounds.

The following goals are suggested:

1. Developing the necessary skills and understandings which will permit the student to enter into and advance in an apprenticeship program or obtain entry-level employment in the building trades.

2. Developing skills and understandings for the interpretation of blueprints, plans, and specifications in the building trades.

3. Understanding the proper use and care of hand tools, materials, and machines used in the building trades.

4. Developing and instilling habits of working safely on the job site and in the laboratory with all tools and equipment.

5. Developing appropriate personal/social attitude through working together and through VICA activities.

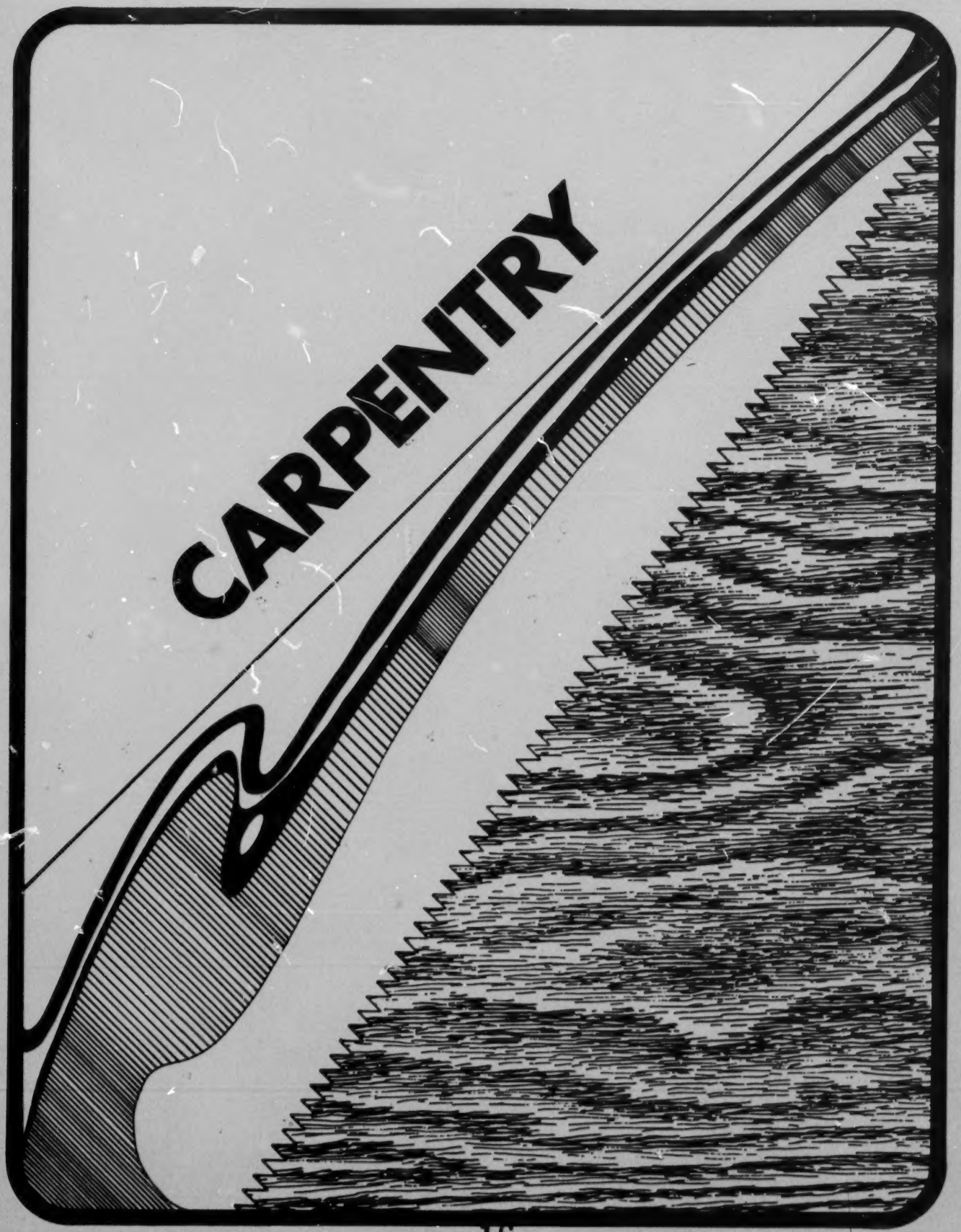
6. Developing an understanding of the role and relationship of related trades in the construction industry.

7. Developing the ability to analyze construction problems and plan methods of repair logically.

8. Developing pride in personal achievements and craftsmanship.

9. Allowing students to learn and develop proper work habits.

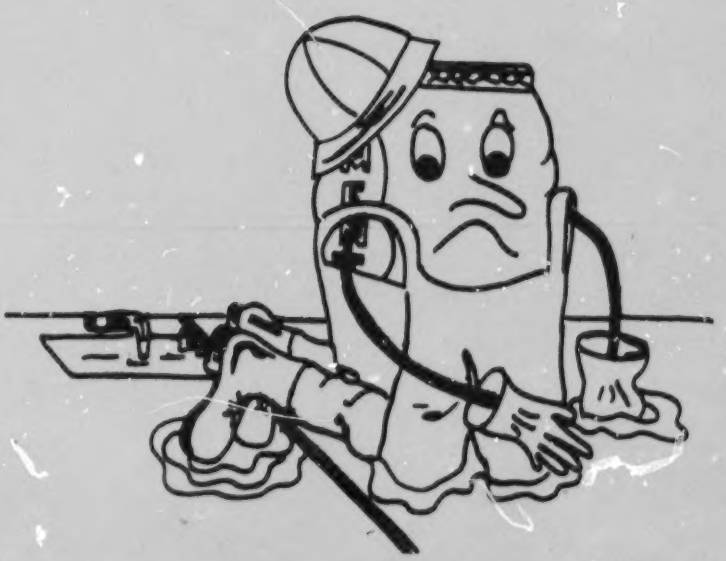
10. Developing values of good housekeeping and personal appearance.


CARPENTRY

CEMENT MASONS

JOB DESCRIPTION

Cement Masons, also called Cement and Concrete Finishers, secure the specified finish on concrete surfaces such as walls, sidewalks, floors, and highways. They use hand and power tools such as trowels, troweling machines, cement finishing machines, floats, screeds, templates, and brushes to level fresh concrete, provide the proper contour, and obtain a smooth or decorative finish. In addition, Cement Masons may supervise the subgrading of ground, mixing and pouring of concrete, and erection of forms. Most work on new construction, but some work in maintenance and repair.



TRAINING AND QUALIFICATIONS

Most workers enter this trade through an established three-year apprenticeship program, but a few have learned the trade as helpers. A high school diploma or its equivalent is required for entry into apprenticeship training. Courses in blueprint reading, architectural drawing, mathematics and related courses are particularly helpful. Good physical coordination is necessary because of the physical activity required. Also important are good eye-arm coordination and manual dexterity.

WAGES

Currently, union scale for journeymen Cement Finishers is $7.58 per hour. At the beginning level, apprentices are paid 60 percent of the journeymen rate.

ADVANCEMENT

A few Cement Masons with years of experience may advance to Foremen or become Estimators of material requirements and labor costs for concrete contractors. Others may start their own concrete contracting business.

WHERE EMPLOYED

In 1970, there were about 65,500 Cement Masons employed in the United States. In 1970, an estimated 925 of these workers were employed in Arizona. Nearly three-fourths were employed in Maricopa County and about one of every seven were employed in Pima County. Most were employed by construction contractors, although a few specialized in maintenance and repair work.

EMPLOYMENT OUTLOOK

Employment of Cement Masons in Arizona will continue to increase since an increasing population will require more homes, buildings, streets and sidewalks. Between 1973 and 1978 there will be an estimated 440 additional Cement Masons employed in Arizona. Nearly 80 percent of these additional workers are expected to be employed in Maricopa County with about 16 percent being employed in Pima County.

CEMENT MASONS INSTRUCTIONAL ANALYSIS

A. Studying blueprints and specifications

TASKS	INFORMATION TOPICS
1. Gather measurement and quantities data	1. Estimating materials needed
2. Determine schedule of operations	
3. Determine equipment needs	
4. Determine crew size and skills	

Objectives for studying blueprints and specifications

A.1 Given a complete set of blueprints and specifications the student will show on paper the data needed and calculate the quantity of concrete needed for a given project to within $50 of the instructor's estimate.

A.2 Before the project begins each student will be able to state the equipment needed and list the tasks which must be completed to the instructor's satisfaction.

A.3 Before the project is started the students will list the number of workers in each crew and the skills needed to complete the assigned project to the instructor's satisfaction.

B. Preparing area for work

TASKS	INFORMATION TOPICS
1. Check grade points	1. Portland cement
2. Set batter boards	2. Raw materials
3. Arrange excavation	3. Job-mixed concrete
4. Lay forms	
5. Collect proper tools and equipment	
6. Compact area	
7. Install reinforcing steel	
8. Install reinforcing wire mesh	
9. Set expansion joints	

Objectives for preparing area for work

B.1 Given the proper equipment, the students will check the grade points by finding the proper elevations on the grade stakes to the satisfaction of the instructor.

B.2 After proper demonstration, the students will set batter boards and check the squareness of the corners using the 6,8,10 method to the satisfaction of the instructor.

B.3 Provided with equipment, the students will excavate a building site properly digging the footings using proper tools to the satisfaction of the instructor.

B.4 Following proper instructions, the students will build concrete forms by using the proper methods and equipment to the satisfaction of the instructor.

B.5 Before pouring concrete for the assigned project, the students will collect the proper tools and equipment needed to complete the pouring and finishing of the concrete.

B.6 Before the students pour the needed concrete required for the given project, the students will properly lay any reinforcing steel and mesh needed to meet any existing building codes using the equipment needed.

C. Pouring concrete

TASKS	INFORMATION TOPICS
1. Order out concrete	1. Ordering concrete
2. Make pour (footing, stem wall, floor)	2. Placing concrete
3. Vibrate	3. Finishing and curing
4. Screed	
5. Float	
6. Finish	
7. Cure	
8. Pull forms	

Objectives for pouring concrete

C.1 After inspection of the forms, the students will call a company and order the required concrete using proper specifications to the instructor's satisfaction.

C.2 Students will pour a footing, stem wall, and floor on an assigned project using the proper equipment so as to pass the instructor's inspection.

C.3 During and after the pouring of concrete the student will vibrate the concrete using the proper equipment so that the surface will be free from honeycomb and other visible defects.

C.4 After vibrating the concrete on the assigned project, the students will screed the concrete using the proper tools to the instructor's satisfaction.

C.5 After screeding the concrete on the assigned project the students will float the concrete using the proper tools so as to pass the instructor's inspection.

C.6 The students will finish the concrete on the assigned project using the tools necessary to achieve the proper finish required by the blueprints.

C.7 At the conclusion of finishing the concrete on the assigned project the students will cure out the concrete using the methods and materials specified on the plans to the instructor's satisfaction.

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CARPENTERS

JOB DESCRIPTION

Carpenters comprise the largest single group of workers in the building trades. This is a result of their being involved in nearly every phase of construction activity. For example, they either build the forms needed to pour concrete or erect the wooden framework for walls in buildings. Later in the construction process they install flooring, cabinets, doors or hardware. Finally, they install finishing materials such as paneling, acoustical tile or molding. Because of the wide scope of the work performed in this occupation, Carpenters, especially those working in large cities or on large projects, frequently specialize in a particular type of carpentry; for example, laying parquet floors, building stairs, or installing finish hardware. Carpenters residing in small towns frequently perform all phases of carpentry from erecting rough wooden framework to installing finished cabinets. Carpenters use a variety of hand tools and power tools such as saws, hammers and drills to saw, fit and attach wood, wallboard and other materials.

The skilled Construction Carpenter (DOT NO. 860.381): constructs, erects, installs and repairs structures and fixtures of wood, plywood, and wallboard (using Carpenter's hand tools and power tools, and conforming to local building codes); studies blueprints, sketches, or building plans for information pertaining to type of material required (such as lumber or fiberboard, and dimensions of structure or fixture to be fabricated); selects specified type of lumber or other materials; prepares layout, using rule, framing square and calipers; marks cutting and assembly lines or materials, using pencil, chalk, and marking gage; shapes materials to prescribed measurements, using saws, chisels, and planes; assembles cut and shaped materials and fastens them together with nails, dowel pins or glue; verifies trueness of structure with plumb bob and carpenter's level; erects framework for structures and lays subflooring; builds stairs and lays out and installs partitions and cabinet work; covers subfloor with building paper to keep out moisture and lays hardwood, parquet, and wood-strip-block floors by nailing floors to subfloor or cementing them to mastic or asphalt base; applies shock-absorbing, sound-deadening and decorative paneling to ceilings and walls; fits and installs prefabricated window frames, doors, doorframes, weather stripping, interior and exterior trim, and finish hardware, such as locks, letter drops, and kick plates; constructs concrete forms and pouring chutes; erects scaffolding and ladders for assembling structures above ground level; may weld metal parts to steel structural members.

The "Rough" Carpenter (DOT NO. 860.781): builds rough wooden structures, such as concrete forms, scaffolds, tunnel and sewer supports and temporary frame shelters according to sketches and oral instructions; examines specifications to determine dimensions of

structures, measures boards, timbers or plywood using a square, measuring tape and ruler and marks cutting lines on materials, using a pencil and scriber; saws boards and plywood panels to required sizes; nails cleats (braces) across boards to construct concrete forms; braces forms in place with timbers, tie rods and anchor bolts for use in building concrete piers, footings and walls; installs door and window bucks (rough frames in which finished frames are inserted) in designated positions in building framework; installs subfloors in buildings; nails plaster grounds (wooden or metal strips) to studding to provide a guide for the plasterer; fits and nails sheathing (first covering of boards) on outer walls and roofs of buildings.

In summary, the "Rough" Carpentry entails the erection of wood framework in buildings (including subflooring, sheathing, partitions, floor joists, studding and rafters), the installation of heavy timbers used in the building of docks, railroad trestles, and similar heavy installations. The finishwork Carpenters install molding around floors and ceilings, wood paneling, cabinets, window sashes, door frames and hardware. They also build stairs and lay floors. Although a journeyman is expected to know all aspects of carpentry work; there is much specialization within the trade. Specialization is more common in cities.

TRAINING AND QUALIFICATIONS

Completion of a formal four- or five-year apprenticeship program is the best mode of entry into this occupation. High school courses helpful to prospective Carpenters include woodshop, blueprint reading, mechanical drawing, algebra, geometry, and Building Trades I and II. New entrants to the trade will find difficulty gaining entry without high school graduation. Entrants should be at least 17 years of age, have above-average finger and manual dexterity, good eye-hand-foot coordination, physical strength, mechanical aptitude, and form perception. Generally, Carpenters are required to have their own hand tools.

WAGES

Apprentice earnings start at $6.35 and progress to $7.97. The 1972-73 Arizona journeyman rate is approximately $8.10 per hour for the central and southern areas of the state and $9.97 for the northern area.

ADVANCEMENT

The normal line of promotion for a Carpenter is to Foreman. A few gain promotion to General Construction Foreman and some go into business for themselves, contracting for new construction or remodeling work.

WHERE EMPLOYED

In the United States in 1970, there were about 830,000 Carpenters employed. In Arizona there were 7,144. Fifty-two percent were employed in Maricopa County and 21 percent in Pima County. The majority of carpenters in the State work for construction firms.

EMPLOYMENT OUTLOOK

Between 1973–78 it is expected that 3,540 new job opportunities will exist in Arizona. Fifty-six percent of these jobs will exist in Maricopa County and 24 percent in Pima County. Construction activity in the future is expected to experience sporadic growth. The abnormally high demand expected at specific times in the future can probably be met by the experienced Carpenters who are attracted by construction activity.

CARPENTERS INSTRUCTIONAL ANALYSIS

A. Reading blueprints, specifications, and estimating

TASKS	INFORMATION TOPICS
1. Read and study blueprints and specifications	1. Introduction to a set of house plans
2. Interpret symbols and abbreviations	
3. Visualize buildings from working drawings	
4. Analyze datum point and elevations	4. Zoning permits, building codes and inspections
5. Develop materials list from specifications and blueprints	
6. Calculate costs for site preparation and excavation	
7. Calculate quantity and costs for concrete	7. Introduction to specifications
8. Determine quantity and costs for masonry	8. Estimating for the building trades
9. Establish quantity and costs for carpentry	
10. Calculate quantity and costs for electrical	
11. Calculate quantity and costs for plumbing, heating, and ventilation	

Objectives for reading blueprints, specifications, and estimating

A.1 Given a complete set of blueprints and specifications, the student will be able to answer a fifty question true–false and multiple choice test on the building's materials and structure with 90 percent accuracy.

A.2 Given a complete set of blueprints and specifications, each student will identify fifteen (15) symbols and abbreviations used on the set of plans on an individual oral examination by the instructor with 100 percent accuracy.

A.3 At the end of the unit, each student will be able to develop a complete materials list and calculate the cost of materials for the building to within ten percent of the instructor's estimate.

B. Framing a building

TASKS	INFORMATION TOPICS
1. Install termite shield	1. Safety on the job

2.	Install and plumb posts to support beam	2. Methods of framing
3.	Cut, assemble and install a built-up beam	3. The framing square
4.	Lay out, cut and anchor sill	4. Floor framing
5.	Lay out floor joist	
6.	Position and fasten floor joist	
7.	Lay out and cut bridging	
8.	Install bridging to specifications	
9.	Install T & G plywood sub-flooring	
10.	Use pneumatic nailer for applying sub-floor	
11.	Select and cut plates	11. Wall framing
12.	Lay out plates for studs and cripple studs	
13.	Cut studs to length	
14.	Lay out and cut headers	
15.	Assemble headers	15. Building materials
16.	Build corner posts	
17.	Build partition posts	
18.	Rough frame all openings	
19.	Nail exterior wall section	
20	Plumb brace and align exterior walls	
21.	Nail interior wall section	
22.	Raise interior wall sections	
23.	Plumb brace and align interior walls	
24.	Nail interior walls to specifications	
25.	Cut and install double plates	
26.	Cut and nail wall sheathing to exterior walls	
27.	Install bats between studs	27. Thermal and sound control
28.	Distribute loose fill between open ceiling joists	
29.	Lay vapor barrier in designated areas	

Objectives for framing a building

B.1 Provided with bearing posts, the student will erect the posts plumb and in the correct positions to support a beam.

B.2 Provided with proper materials, the student will place the beam level and in the correct position.

B.3 The student will lay out and secure the sill as determined by the blueprints.

B.4 Student will determine the size and fasten the floor joists according to the plans and specifications.

B.5 The students will establish the type of bridging and secure bridging according to plans and specifications.

B.6 The student will determine the type of subfloor and nail subfloor with pneumatic nailer.

B.7 Given a selection of lumber, the student will construct corner posts according to the plans and specifications.

B.8 From the proper materials, the student will lay out, cut, and assemble exterior walls erect and plumb and properly brace them in their correct locations. All wall sections will be within ±1/8" of dimensions.

B.9 With access to a supply of lumber, the student will construct interior partitions to within ±1/8" and plumb and brace.

B.10 Student will determine the type of sheathing required and cut and install sheathing according to specifications.

B.11 From the plans and specifications, the student will determine the proper building paper to be used and fasten it to the sheathing to the satisfaction of the instructor.

B.12 Using the plans and specifications the student will determine the siding to be used and fasten same to the building.

B.13 Student will determine the proper corner pieces to be used and the correct placement of same from the plans and specifications.

B.14 The student will determine the types of insulation required and install batts into walls and distribute loose fill in ceiling according to specifications.

C. Framing a roof

TASKS	INFORMATION TOPICS
1. Cut and install ceiling joists	1. Types of roofs
2. Lay out and cut common rafters	2. Types of rafters and joists layout

3. Lay out and cut hip rafters
4. Lay out and cut valley rafters
5. Lay out and cut jack rafters
6. Lay out ridge board
7. Anchor rafters in place
8. Cut and install collar ties
9. Brace rafters
10. Rough frame louver openings
11. Lay out, cut and install gable end studs
12. Build up and install projection at gable ends
13. Rough frame openings for chimney
14. Rough frame openings for ventilators
15. Construct a truss
16. Cut and install sheathing
17. Install roof vents
18. Cut and apply felt paper
19. Cut and apply valley flashing
20. Cut and apply drip edge flashing
21. Apply metal step flashing to chimney
22. Lay starter row of asphalt shingles
23. Cover roof using asphalt shingles
24. Apply wood shingles to roof
25. Apply roll roofing
26. Apply mastic cement

7. Scaffolding safety

18. Cut and apply felt paper

Objectives for framing a roof

C.1 Provided with the proper materials, each student will lay out, cut, and install joists and rafters according to blueprints and within ±1/8" of dimensions.

C.2 With access to sheathing materials, the student will cut and install materials according to specifications and code standards.

C.3 Using materials provided, the student will install metal drip edge and flashings according to specifications and code and subject to visual inspection of the instructor.

C.4 Student will install roof shingles according to specifications, code, and subject to visual inspection.

D. **Finishing the exterior**

TASKS	INFORMATION TOPICS
1. Read blueprints for window symbols	1. Safety on the job
2. Identify types of windows	
3. Install double hung window	3. Cornice
4. Install awning type window	
5. Install sliding type window	
6. Install casement type window	
7. Assemble a door frame	
8. Install a door frame	
9. Install fascia boards	
10. Install lookouts	
11. Install soffit	
12. Install frieze board and trim	
13. Install vents	13. Types of siding
14. Apply bevel siding	
15. Apply board and batten siding	

16. Apply tongue and groove siding
17. Apply wood shingles to exterior wall
18. Install starter strip for aluminum siding
19. Apply aluminum siding
20. Install necessary moldings
21. Lay out and cut siding for gable ends
22. Caulk siding

Objectives for finishing the exterior

D.1 At the end of the course, the student will be able to lay out, cut, assemble and fit wood siding to blueprint specifications.

D.2 Given a wall with a rough opening in it for a window and a window to be installed, the student will be able to install the window so that the top and bottom are level, the sides, plumb, and the window functions properly.

D.3 Given a door, a door frame, sash and trim, door stop, hinges, and the necessary tools, the student will be able to set the door frame, hang it, and install the door step, all plumb and square.

D.4 Given cornice types and designs, the student will be able to identify and construct each to blueprint specifications. (soffits)

E. Finishing the interior

TASKS	INFORMATION TOPICS
1. Cut and install gypsum wallboard on ceiling	1. Safety
2. Apply ceiling tile to firring strips	
3. Hang suspended ceiling	3. Interior wall coverings
4. Cut and install gypsum wallboard	
5. Locate and fasten plaster ground	5. Floors
6. Install corner bead	
7. Cut and fasten paneling to walls	
8. Install underlayment for wood floor	
9. Lay hardwood floors	
10. Assemble and set door jambs	

11. Trim door openings — 11. Doors and windows
12. Fit door to opening
13. Hang door
14. Hang prehung door
15. Set stops
16. Install door hardware
17. Trim windows
18. Install window hardware and adjust
19. Run base and shoe
20. Cope inside corner moldings
21. Miter outside corner moldings
22. Install closet shelves and rods

Objectives for finishing the interior

E.1 Given a room in which an acoustical tile ceiling is to be applied, the student will be able to fur the ceiling, and apply the tile with ahesives, or staples or nails. Joints must be straight, corners must meet, and the tile against opposite walls must be equal.

E.2 Given a piece of wall material such as sheetrock, the student will be able to lay out, and cut openings for electrical outlets and switches, in such a way that when the cover plate is put on, the hole is completely covered.

E.3 With sheetrock as an outside corner, the student will be able to place the corner bead on the corner, and apply the finishing compound (cement) to it so that it is smooth and straight.

E.4 Given a sheet of plywood, the student will be able to apply it to the wall with an adhesive in such a way that all joints are tight.

E.5 Given a piece of plywood or paneling and a wall to which the paneling or plywood needs to be scribed, the student will be able to scribe the paneling to the wall so there is no more than 1/32" space anywhere along the edge of the paneling or plywood.

E.6 Given a room that is in need of molding, the student will be able to install the moldings with coped joints, on inside corners, and miter joints on outside corners. All joints are to be tight within 1/64".

E.7 Given a hardwood floor and the materials to lay the floor, the student will be able to install the floor and be able to demonstrate the procedure.

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Film Service Laboratories, Inc.
Jefferson Road
Athens, GA 30601

83. *The Changing Forest*

Consulate General of Canada
Film Library
310 South Michigan Avenue
Chicago, IL 60604

FILMS (Continued)

84. *The Endless Forest*
Modern Talking Picture Service
1212 Avenue of the Americas
New York, NY 10036

85. *An Idaho Sawmill*
Idaho Department of Commerce and Development
Room 108, Capitol Building
Boise, ID 83707

86. *A B C of Hand Tools*
General Motors Corporation
Public Relations Staff – Film Library
General Motors Building
Detroit, MI 48202

87. *Big Arm of Dewalt: The Power to Build*
Sterling Movies
Booking Department
43 West 61st Street
New York, NY 10023

88. *It is Up to You*
89. *Expedite School Eye Safety*
90. *The True Story of Wm. Frank of Chicago, Ill.*
Harvest Films Inc.
98 Riverside Drive
New York, NY 10024

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91. *Building a Home*
92. *Building the Frame of a Home*
93. *Building the Shell*
94. *Completing the Outside of a House*
95. *Layout Common Rafters and Open Stairs*
96. *The House is Built*
McGraw-Hill Book Company
330 West 42nd Street
New York, NY 10036

97. *Carpentry & Wood Finishing*
98. *Hanging Doors*
99. *Making Stairs*
100. *Cutting Rafter Patterns*
Kavic House
1 Eaton Court
Wellesley Hills, MA 02181

TRANSPARENCIES

101. *House Framing – Part I and II*
102. *Roof Framing, Part I and II*

3-M Company, Visual Products
Box 3100
St. Paul, MN 55101

103. *Wood Technology* (complete series)

DCA Educational Products Inc.
4865 Stenton Avenue
Philadelphia, PA 19144

104. *Carpentry – Exterior Trim*
105. *Carpentry – Interior Trim*
106. *Carpentry – Staircase Construction*

3-M Company, Visual Products
Box 3100
St. Paul, MN 55101

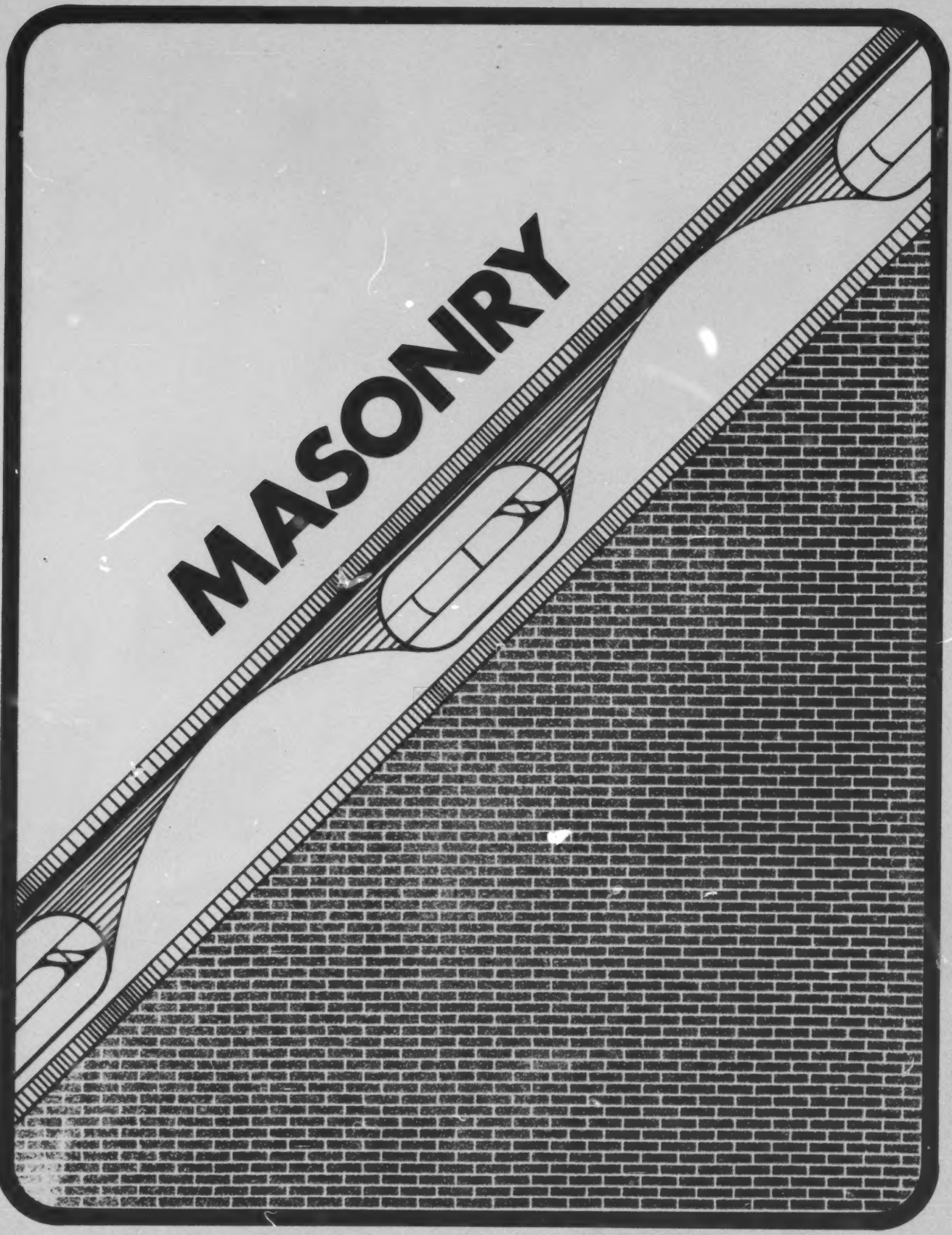
TEACHING AIDS

107. *Scale Model Construction Kits*

Brodhead-Garret
161 Commerce Circle
Sacramento, CA 95815

108. *Powertool Wall Charts*

School Aids Department
Power Tool Division
Rockwell Manufacturing Company
400 North Lexington Avenue
Pittsburgh, PA 15208


MASONRY

BRICKLAYERS

JOB DESCRIPTION

Bricklayers construct walls, partitions, fireplaces, chimneys, and other structures of brick, concrete block, hollow tile, structural glazed tile, adobe block, building stone, and glass block. They also install and repair fine brick kilns, industrial furnaces and ovens. Some Bricklayers work with acid brick installing floors, acid tanks, and protective walls. There are many Bricklayers who are qualified to work with all of these different types of material, while some Bricklayers specialize in working in one particular field, i.e., acid work, firebrick work or outside construction. They determine from blueprints the exact specifications and dimensions of the structure to be built. They use tools such as trowels, jointers, brick hammers, brick sets, levels, spacing rules, and line pins.

TRAINING AND QUALIFICATIONS

The normal method of entry into bricklaying occupations is through an established apprenticeship program. An apprentice usually has above average aptitude and physical fitness, an average level of intelligence, more-than-ordinary ability to work with his hands, perseverance, ambition, and initiative. He is usually between the ages of 17 and 26 and has a high school diploma or equivalent. Bricklaying is hard physical labor and should not be entered into by those who cannot stand the heat of summer and the cold of winter. A journeyman Bicklayer is normally required to furnish his own tools which cost about $100.00.

WAGES

The union scale for journeyman Bricklayers is $9.07 per hour plus a health and welfare program, pension plan, and life insurance. The apprentice Bricklayer starts at 40 percent of the scale and is advanced each six months until he receives his card, then he receives the scale. This is a three year program.

ADVANCEMENT

Journeyman Bricklayers who are outstanding at the trade become Foremen. They become estimators or establish their own businesses as masonry contractors.

WHERE EMPLOYED

There were about 175,000 Bricklayers working in the United States in 1970. In Arizona there were 1,735. Fifty-five percent were employed in Maricopa County and 26 percent in Pima County. Less than one percent of Bricklayers in the State were women. Over 90 percent of all Bricklayers are employed in the construction industry. The rest are engaged in providing maintenance and repair services in manufacturing and government establishments.

EMPLOYMENT OUTLOOK

As Arizona's population continues to grow, the number of Bricklayers needed by the construction industry will continue to increase. It is estimated that between 1973–78, there will be 770 new job opportunities for Bricklayers in Arizona. Eighty-eight percent of these jobs will exist in Maricopa and Pima counties.

BRICKLAYERS INSTRUCTIONAL ANALYSIS

A. Studying blueprints, specifications, estimating masonry units, taking off material quantities, and preparing a materials estimate.

TASKS	INFORMATION TOPICS
1. Read specifications and make proper notations	1. Manufacturing and application of lime
2. Make work sheet	2. Manufacturing cement
3. Take measurements and arrange in proper order	3. Manufacturing, gradation and specifications of sand
4. Determine number of concrete block	4. Formulas, proportions and quantities of mortar
5. Determine number of brick	5. Testing according to ASTM–C270
6. Calculate quantities of miscellaneous items	
7. Calculate total number of masonry units	
8. Calculate mortar	
9. Complete masonry material estimate	

Objectives for studying blueprints, specifications, estimating masonry units, taking off material quantities and preparing a materials estimate.

A.1 Given a copy of the specifications for this project, the student will make notations showing any special items of material or instructions which will effect this estimate. These notations will be submitted to the instructor for his approval.

A.2 Given a complete set of blueprints, the student will, after proper instructions, make up a work sheet listing each size and kind of masonry material required for this estimate to the satisfaction of the instructor.

A.3 Using the blueprints, the student will take off measurements of the masonry portion of the building. Student keeps each size of material separate and in square foot totals. These totals shall be within a reasonable amount of the instructor's totals.

A.4 Given a table containing quantities required per square foot for construction of walls with various block sizes, the student will calculate the number of block units required per square foot for each of the different sized units required for this estimate, and enter in appropriate column on his work sheet. Instructor will check for 100 percent accuracy.

A.5 Given a table containing quantities required per square foot for construction of walls with various brick sizes, the student will follow same procedure as that in A.4. Instructor will again check for 100 percent accuracy.

A.6 After proper instructions, the student will refer to blueprint and take off quantities of all miscellaneous items which are covered under the masonry section of the specifications, i.e.: lintels, reinforcing steel, bolts, anchors, etc., write totals in appropriate columns on work sheet to the satisfaction of the instructor.

A.7 After proper demonstration, the student will calculate the total lumber or masonry units needed to complete the estimate and enter totals in the appropriate column on the work sheet, to the satisfaction of the instructor.

A.8 Following a demonstration of proper procedure by the instructor, the student will be given a copy of ASTM—C220 and a table of mortar quantities required for block and brick. He will then calculate the number of sacks of cement, sacks of lime, and cubic yards of sand required to complete the masonry for this project. The student will enter totals in the proper columns on his work sheet to the satisfaction of the instructor.

A.9 Following proper instructions, the student will complete his work sheet checking all totals for accuracy. When estimate is complete, the student will hand it in to the instructor for evaluation. Student's estimate must be within a reasonable amount of the instructor's estimate.

B. Using tools of the trade.

TASKS	INFORMATION TOPICS
1. Spread mortar with brick trowel	1. Process of manufacturing block
2. Lay masonry units to a line	2. Recognizing the different shapes and sizes of concrete masonry units
3. Strike mortar joints with a jointer	3. Uses of typical concrete masonry units
4. Level masonry with a mason's level	4. Selecting surface finishes and colors of C.M.U.
5. Plumb masonry with a mason's level	5. Laying out wall patterns
6. Measure masonry for height and length with mason's rule	6. Painting concrete masonry

7. Cut masonry units with a hammer and set
8. Cut masonry units with a trowel
9. Build corners, leads, and angles

Objectives for using tools of the trade.

B.1 After proper demonstration, the student will spread mortar, with a brick trowel, for brick and concrete block to the satisfaction of the instructor.

B.2 After proper demonstration, the student will lay brick and concrete block to a line to the satisfaction of the instructor.

B.3 Following proper instructions, the student will strike mortar joints with an "s" jointer and a sledrunner jointer to the satisfaction of the instructor.

B.4 After proper demonstration, the student will level masonry with a mason's level to the satisfaction of the instructor.

B.5 After proper demonstration, the student will plumb masonry with a mason's level to the satisfaction of the instructor.

B.6 Following proper instructions, the student will measure masonry for height and length with a mason's rule to the satisfaction of the instructor.

B.7 After proper demonstration, the student will cut masonry units to various lengths with a hammer and bricklayer's set to the satisfaction of the instructor.

B.8 After proper demonstration, the student will cut masonry units to various lengths with a brick trowel to the satisfaction of the instructor.

B.9 Following proper instructions and demonstration, the student will build corners, leads, and angles using brick trowel, level, mason's rule, and jointer to the satisfaction of the instructor.

C. Construct masonry structure.

TASKS	INFORMATION TOPICS
1. Study sketch of structure	1. Process of manufacturing clay
2. Collect proper material	2. Recognizing the different kinds of brick
3. Lay out story structure	3. Bonding and types of bonds
4. Make story pole	4. Finishing the joints in brickwork

5. Lay up leads, corners, or angles
6. Build walls
7. Place horizontal and vertical reinforcement
8. Complete structure
9. Strike and brush structure
10. Clean up area

5. Laying out typical brick masonry details
6. Maintaining brick walls

Objectives for constructing masonry structure.

C.1 Students will study sketch of structure to determine type of material to be used.

C.2 Students will collect material needs from stockpiles and move the material to their work area. Stock material to the satisfaction of the instructor.

C.3 Students will lay out bond as specified in the sketch to the satisfaction of the instructor.

C.4 After proper demonstration, the student's will consult sketch and make a story pole with proper coursing for height to the satisfaction of the instructor.

C.5 Students will build leads, corners, and angles needed for the assigned structure. Leads, corners, and angles will be plumb, level and true to the satisfaction of the instructor.

C.6 Students will string a line between corners, leads, or angles and build walls to the satisfaction of the instructor.

C.7 Students will place horizontal and vertical reinforcement as the structure is being built in accordance with the sketch of the structure.

C.8 Students will complete the assigned structure as shown on the sketch of the structure to the satisfaction of the instructor.

C.9 After proper demonstration the students will strike and brush structure to the satisfaction of the instructor.

C.10 Students will clean their work area and move all unused material back to stockpiles, clean all equipment and tools to the satisfaction of the instructor.

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PLUMBING

PLUMBERS AND PIPE FITTERS

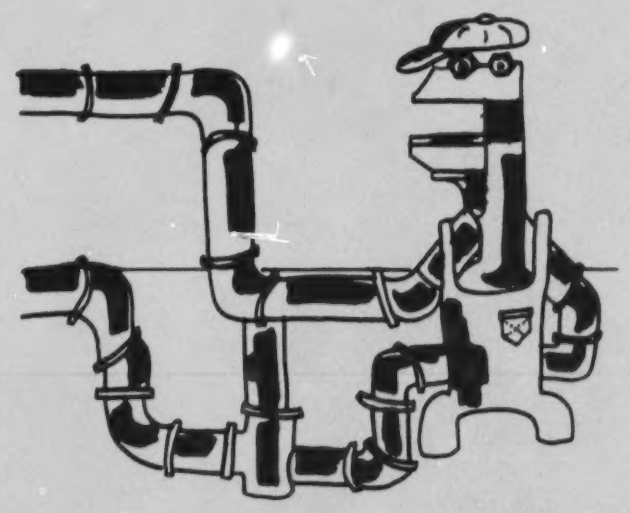
JOB DESCRIPTION

Plumbers and Pipe Fitters are skilled workers who install, alter, and repair the pipe systems used to conduct air, gas, water, sewage, or steam. The Plumber installs and repairs such things as bathroom fixtures, sinks, gas stoves, furnaces, and automatic laundry equipment. Steam Fitters install and repair high pressure piping systems such as those used for ammonia distribution in refrigeration plants, compressed air lines, complex systems for chemical and food processing plants, and steam distribution systems. They normally work in commercial or industrial buildings. Gas Fitters install and maintain the gas fittings and the central gas main extensions which connect individual users with the main source of supply. Sometimes workers may be qualified in several of these occupations; however, the trend is for workers to specialize in only one of the fields.

The Construction Plumber (DOT NO. 862.381): assembles, installs, and repairs pipes, fittings and fixtures of heating, water, and drainage systems, according to specifications and plumbing codes; studies building plans and working drawings to determine work aids required and sequence of installations; inspects structure to ascertain obstructions to be avoided to prevent weakening of structure resulting from installation of pipe; locates and marks position of pipe and pipe connections and passage holes for pipes in walls and floors, using ruler, spirit level and plumb bob; cuts openings in walls and floors to accommodate pipe and pipe fittings, using hand tools and power tools; cuts and threads pipe using pipe cutters, cutting torch, and pipe threading machine; assembles and installs valves, pipe fittings, and pipes composed of metals, such as iron, steel, brass, copper and lead, and nonmetals such as glass, vitrified clay, and plastic, using hand tools and power tools; joins pipes by use of screws, bolts, fittings or solder, and caulks joints; fills pipe system with water or air and reads pressure gages to determine whether system is leaking; installs and repairs plumbing fixtures such as sinks, commodes, bathtubs, waterheaters, hot water tanks, garbage disposal units, dishwashers, and water softeners; repairs and maintains plumbing, by replacing washers in leaky faucets, mending burst pipes, and opening clogged drains.

TRAINING AND QUALIFICATIONS

Entrance into these occupations is usually through a five-year apprenticeship program, although some workers have learned the trade through on-the-job training or working as helpers for several years. High school education or its equivalent is required for entry into an apprenticeship program. Vocational and high school courses which would be helpful are general machine shop, mechanical drawing, general science, algebra, geometry, blueprint reading, and Building Trades I and II. Personal characteristics considered essential to success are the physical strength and stamina necessary to climb, lift,



and carry heavy objects, good manual dexterity, and good eye-hand coordination. Workers in this occupation are normally required to have their own hand tools.

WAGES

Plumber and Pipe Fitter apprentices begin at about $3.65 per hour. Union scale for journeymen Plumbers and Pipe Fitters is currently $8.10 per hour.

ADVANCEMENT

Journeymen with sufficient experience may be promoted to Foremen. A few eventually advance to General Foreman or Superintendent in large contracting firms. Many journeymen go into business for themselves.

WHERE EMPLOYED

More than 380,000 Plumbers and Pipe Fitters were employed in the United States in 1970. Most Plumbers and Pipe Fitters are employed by plumbing and pipe fitting contractors in new construction activity, mainly at the construction site. Nearly 2,900 Plumbers and Pipe Fitters were employed in Arizona in 1970 with about 55 percent of those employed in Maricopa County and 21 percent in Pima County.

EMPLOYMENT OUTLOOK

The employment of Plumbers and Pipe Fitters will increase rapidly because the growth of population and industry will require additional construction of homes and buildings as well as maintenance and repair. It is expected that between 1973–78 an additional 1,380 Plumbers and Pipe Fitters will be employed in Arizona. An estimated 59 percent of these jobs will be in Maricopa County and 24 percent in Pima County. Opportunities for qualified persons to enter training for these occupations will be good through the 1970's.

JOBS AVAILABLE IN PIPE FITTING INDUSTRY

1. Pipe and Test Foreman
2. Pipe-Bending-Machine Operator
3. Pipe Caulker
   a. joint man
   b. joint runner
   c. leak repairman
   d. pipe joint sealer
   e. pipe leak repairman
   f. pipeman, caulking
   g. slip-joint pourer
4. Pipe-Cleaning and Priming-Machine Operator
5. Pipe-Cleaning Machine Operator
6. Pipe Cutter
7. Pipe Fitter (plumber)
8. Pipe Fitter
   a. acetylene welding
   b. electric arc welding
9. Pipe Fitter (ammonia)
10. Pipe Fitter Apprentice
    a. air conditioning (heat pump)
    b. refrigeration
    c. steam fitter
    d. sprinkler systems
11. Pipe Fitter Foreman
12. Pipe Fitter
    a. gas pipe
    b. plastic pipe
    d. soft copper
13. Pipe Layer
    a. cast-iron layer
    b. pipe setter
    c. sewer-pipe layer
    d. water-pipe layer
14. Pipe Laying Foreman
15. Pipe-Line Foreman
16. Pipe-Line Worker
17. Pipe-Machine Operator
18. Pipe-Line Construction Inspector
19. Pipe-Threader (hand)
20. Pipe-Wrapping Machine Operator

PLUMBERS AND PIPE FITTERS INSTRUCTIONAL ANALYSIS

A. **Preparing materials.**

TASKS	INFORMATION TOPICS
1. Read blueprints	
2. Locate plumbing fixtures	
3. Study specifications	
4. Consult code and regulations	4. Uniform plumbing code
5. Determine equipment and materials and sequence of installing	5. Plumbing inspection procedures
6. Lay out and align passage holes	
7. Cut and bevel pipe	
8. Deburr materials	
9. Thread pipe	
10. Form pipe	
11. Clean pipe	
12. Preheat materials	

Objectives for preparing materials.

A.1 Given the necessary blueprints and working drawings, the student will be able to locate the correct position of supply and waste lines and identify plumbing fixtures with 100 percent accuracy.

A.2 Given the necessary building plans and working drawings the student will determine the equipment and a logical sequence of installation of plumbing for a residential structure to the satisfaction of the instructor.

A.3 Provided with: hand hacksaw, power hacksaw, pipe cutter, abrasive wheel, burning torch, chisel, glass cutter, metal snips, and rasp the student will lay out and cut various types of pipe to within $\pm 1/16''$ of dimensions and to pass instructor's inspection.

A.4 Given the proper tools the student will cut, thread, bend and otherwise prepare pipe composed of: lead, aluminum and aluminum alloys, copper and copper alloys, brass, clay, glass, stainless steel, plastic, cast iron, nickel and nickel alloy steels, carbon and low carbon steels, and transite which is appropriate for residential structures to the satisfaction of the instructor.

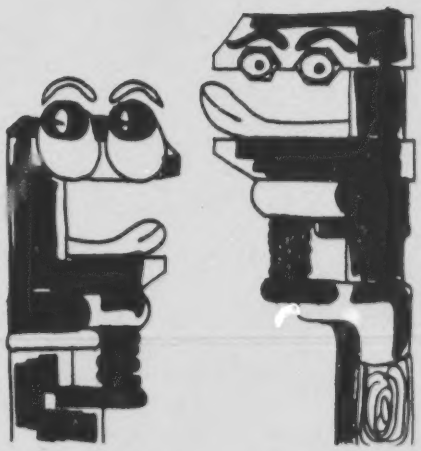
B. Joining materials.

TASKS	INFORMATION TOPICS
1. Couple with flare connectors	
2. Couple with compression connectors	2. Types of pipe and their uses
3. Couple with threaded sleeves	
4. Couple with compression sleeves and "o" rings	
5. Couple with caulking sleeves	
6. Couple with unions	
7. Couple with flanges, bolts, and gaskets	
8. Caulk with lead	
9. Caulk with oakum	9. The art of caulking
10. Caulk with tar compounds	
11. Caulk with cement	
12. Caulk with patented inserts	
13. Solder with wiping solder	13. Types of solders and their uses
14. Solder with soldering iron and solder	
15. Solder with heating torch and solder	
16. Braze with oxyacetylene torch and filler metal	16. Welding techniques
17. Braze with oxyhydrogen torch and filler metal	17. Bonding with adhesives
18. Braze with other gases, torch, and filler metal	

Objectives for joining materials.

B.1 Provided with the proper materials and after a demonstration by the instructor, the student shall connect a sample test unit utilizing threaded joints. Threads on iron pipe size (I.P.S.) pipe shall be standard taper pipe threads. Tubing threads shall conform to fine tubing thread standards. All burrs shall be removed. Pipe ends shall be reamed or filed out to full size of bore and all chips shall be removed. If a pipe joint material is used, it shall be applied only on male threads and such materials shall be of approved types, insoluble in water and non-toxic. Cleanout plugs and caps shall be lubricated with a water-soluble non-hardening material. Joints and

connections in the unit shall be gas-tight and watertight for the pressures required by test for that type of jointed unit.



B.2 Provided with the proper materials and after a demonstration by the instructor, the student shall connect a sample test unit utilizing solder and sweat joints. Joints in copper tubing shall be made by the appropriate use of approved brass or copper fittings. Surface to be joined by soldering shall be cleaned bright by manual or mechanical means. The joints shall be properly fluxed with an approved non-corrosive type flux and made up with approved solder. All solder and fluxes shall be manufactured to approved standards. Joints and connections in the unit shall be gastight and watertight for the pressures required by test for that type of jointed unit.

B.3 Provided with the proper materials and after a demonstration by the instructor, the student shall connect a sample test unit utilizing solvent weld-plastic pipe. Solvent weld-plastic pipe and fittings designed to be joined by solvent welding shall have a surface free of burrs, dust, dirt and moisture. A moderate even coating of solvent cement shall be applied to the pipe end and to the socket of the fitting. Joint shall be made quickly by inserting the pipe into the fitting socket to its full depth. All solvent weld materials shall be manufactured to approved recognized standards. Joints and connections in the unit shall be gastight and watertight for the pressures required by test for that type of jointed unit.

B.4 Provided with the proper materials and after a demonstration by the instructor, the student shall connect a sample test unit utilizing wiped joints. Joints in lead pipe or fittings or between lead pipe or fittings and brass or copper pipe, ferrules, solder nipples or traps, shall be full-wiped joints. Wiped joints shall have an exposed surface on each side of a joint not less than three-fourths (3/4) inch and at least as thick as the material being jointed. Wall or floor flange lead-wiped joints shall be made by using a lead ring or flange placed behind the joint at wall or floor. Joints between lead pipe and cast iron, steel or wrought iron shall be made by means of a caulking ferrule or soldering nipple. Joints and connections in the unit shall be gastight and watertight for the pressures required by test for that type of jointed unit.

B.5 Provided with the proper materials and after a demonstration by the instructor, the student shall connect a sample test unit utilizing caulked joints. Caulked joints for cast-iron bell-and-spigot soil pipe and other similar joints shall be firmly packed with oakum or hemp and filled with molten lead to a depth of not less than one (1) inch. The lead shall be caulked thoroughly at the inside and outside edges of the joint, after caulking the finished joint shall not extend more than one-eighth (1/8) inch below rim of hub. No paint, varnish or other coatings shall be permitted on the joining material until after the joint has been tested and approved. Joints and connections in the unit shall be gastight and watertight for the pressures required by test for that type of jointed unit.

B.6 Provided with the proper materials and after a demonstration by the instructor, the student shall connect a sample test unit utilizing hot-poured joints. Hot poured compound for clay sewer pipe joints shall conform to recognized standards and shall not be water absorbent and when poured against a dry surface shall have a bond of not less than one hundred (100) pounds per square inch. All surfaces of the joint shall be cleaned and dried before pouring. If wet surfaces are unavoidable, a suitable primer shall be applied. Compound shall not soften sufficiently to destroy the effectiveness of the joint when subjected to a temperature of one hundred and sixty (160) degrees Fahrenheit nor be soluble in any waste carried by the drainage system. Approximately twenty-five (25) percent of the joint space at the base of the socket shall be filled with jute or hemp. A pouring collar, rope or other device shall be used to hold the hot compound during pouring. Each joint shall be poured in one operation until the joint is filled. Joints shall not be tested until one (1) hour after pouring. Joints and connections in the unit shall be gastight and watertight for the pressures required by test for that type of jointed unit.

B.7 Provided with the proper materials and after a demonstration by the instructor, the student shall connect a sample test unit utilizing asbestos cement sewer pipe joints. Joints in asbestos cement pipe shall be a sleeve coupling of the same composition as the pipe and sealed with rubber rings or joined by an approved type compression coupling. Joints between asbestos cement pipe and other approved pipe shall be made by means of an approved adaptor coupling. Joints and connections in the unit shall be gastight and watertight for the pressures required by test for that type of jointed unit.

B.8 Provided with the proper materials and after a demonstration by the instructor, the student shall connect a sample test unit utilizing bituminized fiber pipe joints. Joints in bituminized pipe shall be made with tapered type couplings or fittings of the same material as the pipe or of other compatible non-metallic materials. Joints between bituminous fiber pipe and metal pipe shall be made by means of an adaptor coupling caulked as required in Subsection (a) of this section. Joints and connections in the unit shall be gastight and watertight for the pressures required by test for that type of jointed unit.

C. Installing material and equipment.

TASKS	INFORMATION TOPICS
1. Install soil, waste, and vent pipes	1. Tools and equipment for layout and locating lines
2. Install underground water main	
3. Install drainfield	
4. Install house sewer	
5. Install main sewer	
6. Install reducers	6. Fitting and assembling techniques

7. Install branches	7. Tools and equipment used for rigging
8. Install laterals	
9. Install down spouts	9. Traps and interceptors
10 Install stand pipe	
11. Install offset	
12. Install fitting fabricated from pipe	
13. Install septic tank	
14. Install grease trap	
15. Install bath fixtures	15. Installing fixtures
16. Install drinking fountain	
17. Install kitchen equipment	
18. Install shower pan	
19. Install roof flashing	
20. Install pumps	20. Pumps and their uses
21. Install valves	21. Physics of valves
22. Install fittings	
23. Install sleeves	
24. Install inserts	
25. Install supports	
26. Install hangers	

Objectives for installing material and equipment

C.1 Given the necessary conditions, the student will inspect the building, determine obstructions to avoid, determine piping routes to prevent weakening of the building's structure and facilitate the simplest and most functional plumbing system possible and make a verbal report to the instructor.

C.2 Using a rule, levels and plumb bob, the student will locate and cut the passage holes for pipes and fittings to be located in walls, ceiling and floor. Instructor will check all layout.

C.3 Following the specifications, the student will assemble and rough-in the soil, waste, and vent system according to UPC Chapters 4, 5 and 6.

C.4 Following the proper specifications and plumbing code, the student will assemble and install the plumbing systems for the heating, water and drainage in a residential structure. Installation will be inspected by the local building inspector and the instructor.

C.5 Given the proper tools, the student will install valves, fittings, and pipe composed of iron, steel, copper, vitrified clay and plastic that is appropriate for a residential structure. All installations are subject to inspection.

C.6 The student will demonstrate the procedures for installing sinks, commodes, bathtubs, water heaters, hot water tanks, garbage disposals, dish washers, and water softeners. Fixtures must function properly and pass inspection.

D. **Inspecting and testing.**

TASKS	INFORMATION TOPICS
1. Inspection and test soil, waste, and vent system	1. Sensing with water pressure and gage
2. Test building sewer	
3. Inspect and test drainfield area	3. Compressed air and gage
4. Inspect and test interior leader and down spout	4. Soap solution
5. Inspect and test potable water supply	
6. Inspect and test process water supply	6. Radiology with X-ray tube and sensitive film

Objectives for inspecting and testing. The piping of the plumbing, drainage and venting systems shall be tested with water or air. The inspector or instructor may require the removal of any cleanouts, etc., to ascertain if the pressure has reached all parts of the system. After the plumbing fixtures have been set and their traps filled with water, they shall be submitted to a final test.

D.1 After the installation of the drainage system, the student will set-up and perform a water test on the system. The water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a ten (10) foot head of water. In testing successive sections at least the upper ten (10) feet of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost ten (10) feet of the system) shall have been

submitted to a test of less than a ten (10) foot head of water. The water shall be kept in the system, or in the portion under test, for at least fifteen (15) minutes before inspection starts; the system shall then be tight at all points.

D.2 Upon completion of a section or the entire hot and cold water supply system, the student will set up and test the system. It shall be tested and proved tight under a water pressure not less than the working pressure under which it is the be used. The water used for tests shall be obtained from a potable source of supply. A fifty (50) pounds per square inch air pressure may be substituted for the water test. In either method of test the piping shall withstand the test without leaking for a period of not less than fifteen (15) minutes.

D.3 Students will set up and conduct test on building sewers. Building sewers shall be tested by plugging the end of the building sewer at its points of connection with the public sewer or private sewage disposal system and completely filling the building sewer with water from the lowest to the highest point thereof, or by such other test as may be prescribed by the inspector. The building sewer shall be watertight at all points.

Air Test: The air test shall be made by attaching an air compressor testing apparatus to any suitable opening, and, after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gage pressure of five (5) pounds per square inch or sufficient to balance a column of mercury ten (10) inches in height. The pressure shall be held without introduction of additional air for a period of at least fifteen (15) minutes.

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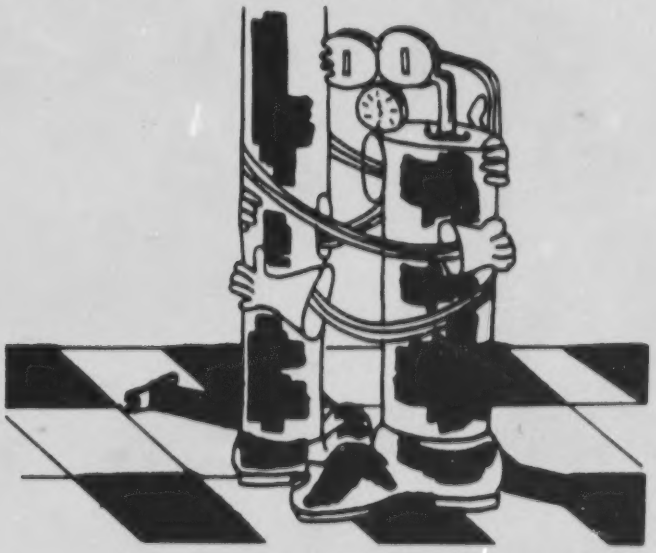
WELDERS

JOB DESCRIPTION

Welders join metals by applying intense heat from gas or electric source to melt the edges of metal pieces to form a permanent bond with or without the use of filler metal. They plan the sequence of operations and select the equipment to be used according to the kind of metals involved and the type of weld to be made. In addition to the traditional electric and gas welding, there is limited use made of atomic, inert gas, and oxyhydrogen welding. Closely related to welding is oxygen and arc cutting (often referred to as flame cutting). Oxygen and arc cutters cut or trim metal objects or castings to a desired size or shape. A Welder who can perform both electric and gas welding is called a Combination Welder.



The Combination Welder (DOT NO. 812.884): welds metal parts together, according to layout, blueprints, or work orders, using both gas welding (Welder, Gas) or brazing (Brazer-Assembler) and any combination of arc welding processes (Welder, Arc; Welder, Atomic; Welder, Gas-Shielded Arc; Welder, Hand, Submerged Arc); performs related tasks, such as repair broken or cracked parts, fill holes, and increase size of metal parts; may position and clamp together components of fabricated metal products preparatory to welding.

Welder, Repair (Welding, Maintenance Welder): repairs worn or damaged machines, fabricated, cast forged, or welded metal parts as specified by sketches, diagrams, or simple parts, using arc or gas welding equipment; examines work piece and measures dimensions for conformance to specifications using tape, rule, or square; tests workpiece for defects, using magnetic testing machine (Inspector, Magnetic—Machine Shop); chips or grinds out holes, bubbles or cracks in workpiece preparatory to filling with weld (Grinding—Chipper); cleans grease or corrosion from workpiece, using wire brush or grinder; clamps broken parts together in jig or vise and welds them using gas or arc welding process, according to type and thickness of metal; may cut defective part from assembly, using bandsaw or cutting torch, and reweld new piece into place; may straighten bent pieces, using hand torch, straightening press, or jack and stanchion; may weld layers of metal onto damaged parts to obtain original dimensions and be designated as Welder, Salvage; may specialize in filling holes, bubbles, and cracks in defective castings and be designated as Welder, Casting, Repair.

TRAINING AND QUALIFICATIONS

Employers prefer to hire fully qualified Welders, but there is some opportunity for on-the-job training. High school or vocational school training is generally preferred including

such courses as general shop, mechanical drawing, mathematics, welding, physics, and blueprint reading. Potential Welders should be able to use independent judgment, have manual and finger dexterity, eye-hand coordination, color discrimination, and be in good physical condition.

WAGES

In general, earnings for Welders vary from $3.85 to $5.50 per hour depending on skill and experience and the type of welding performed.

ADVANCEMENT

Well-qualified, experienced Welders occasionally have opportunity to advance to supervisory positions. A few may establish their own welding and repair shops.

WHERE EMPLOYED

In 1970, approximately 538,000 Welders and Flamecutters were employed in the United States. About 3,810 were employed in Arizona in 1970, with about 53 percent of these employed in Maricopa County and 21 percent in Pima County. Nearly three-fourths of all Welders and Flamecutters are employed in durable goods manufacturing industries. The majority of the remainding Welders and Flamecutters are employed in construction firms and establishments performing miscellaneous repair services.

EMPLOYMENT OUTLOOK

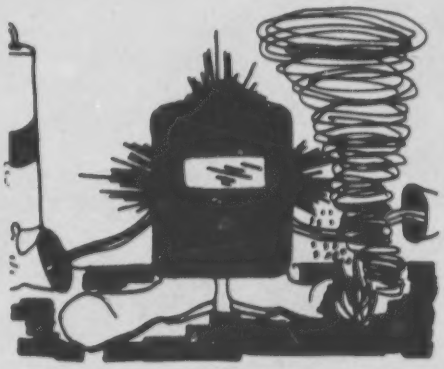
Between 1973–78 it is estimated that the number of jobs for Welders and Flamecutters in Arizona will increase by 1,610 positions with approximately 57 percent of these being in Maricopa County and 24 percent in Pima County.

CLASSIFICATION

Combination Arc Welders and Gas-Welders: This group includes occupations concerned with welding, using gas- and arc-welding equipment.

JOB OPPORTUNITIES

1. Welder Apprentice, Combination (welding)
2. Welder Combination (welding)
3. Welder, Repair (welding, maintenance welder)
4. Welder, Casting Repair (found)
5. Welder, Salvage (welding)
6. Welder, Production Line, (welding)
7. Brazer, Production Line, (welding)
8. Welder, Production Line, Arc (welding)
9. Welder, Production Line, Combination (welding)
10. Welder, Production Line, Gas (welding)



WELDERS INSTRUCTIONAL ANALYSIS

A. Learning safety rules in welding.

TASKS	INFORMATION TOPICS
1. Study the protective equipment used in welding (eyes, face, clothing, etc.)	
2. Practice the different switches on welding machines	2. OSHA compliance
3. Operate the different circuits on welding machines	
4. Practice the proper ventilation techniques in welding	4. Welding safety

Objectives for learning safety rules in welding.

A.1 Given a list of protective equipment used in welding, the student will know what each one is used for with 100 percent accuracy at the end of the unit.

A.2 Given proper instruction on the use of different switches on welding machines, the student will identify by name each machine and its switch with 100 percent accuracy at the end of the unit.

A.3 Given proper instruction in operating welding machines with various circuits, the student will name each circuit and its use with 100 percent accuracy at the end of the unit.

A.4 Given proper instruction in working areas with proper ventilation conditions, the student will demonstrate proper ventilation techniques with 100 percent accuracy.

B. Reading blueprints and specifications.

TASKS	INFORMATION TOPICS
1. Make arithmetic calculations involving fractions, decimals, and percentages	
2. Read illustrations of engineering drawings (drafting)	
3. Reading welding symbols	3. Welding symbols
4. Read blueprints	

Objectives for reading blueprints and specifications.

B.1 Given proper instruction in arithmetic calculations, the student will be able to add, subtract, multiply by means of fractions, decimals, and percentages with 100 percent accuracy at the end of the unit.

B.2 Given sets of drawings pertaining to welding, the student will identify each one without error in regards to the parts that are to be welded at the end of the unit.

B.3 Given sets of drawings and a list of welding symbols, the student will identify and explain the meaning of each symbol with 100 percent accuracy at the end of the unit.

B.4 Given sets of blueprints, the student will identify by name each drawing and explain where welding is to be applied, with 100 percent accuracy at the end of the unit.

C. Using the tools in welding.

TASKS	INFORMATION TOPICS
1. Make arithmetic calculations involving fractions, decimals, and percentages	
2. Measure dimensions of parts by the use of tape, rule, and a square	2. Layout and measurement
3. Use wire brush or grinder	3. Properties of metal
4. Use the jig or vise to weld	
5. Use bandsaw to cut parts	
6. Use the cutting torch	6. Metallurgy

Objectives for using the tools in welding.

C.1 Given proper instructions in arithmetic, the student will be able to add, subtract, multiply, by means of fractions, decimals, and percentages with 100 percent accuracy at the end of the unit.

C.2 Given the following tools to measure with, the student will be able to identify by name and explain its use with 100 percent accuracy at the end of the unit. (Tape measure, square, and straight ruler.)

C.3 Given proper instruction in the use of brush and grinder, the student will use the brush and grinder with 100 percent accuracy at the end of the unit.

C.4 Given proper instruction in the use of jig or vise, the student will demonstrate the proper use of this equipment without error at the end of the unit.

C.5 Given proper instruction in the use of the bandsaw, the student will cut out various shapes using the bandsaw, without error at the end of the unit.

C.6 Given proper instruction in the use of a cutting torch, the student will cut out various shapes using the cutting torch, with 100 percent accuracy at the end of the unit.

D. Welding metal parts together.

TASKS	INFORMATION TOPICS
1. Read blueprints	
2. Position and clamp together components of fabricated metal products to be welded	
3. Use gas welding and brazing	3. Gas welding techniques
4. Use arc welding processes	4. Arc welding techniques
5. Test working pieces with magnetic testing machines	

Objectives for welding metal parts together.

D.1 Given sets of drawings (blueprints) pertaining to welding, the student will be able to identify those parts that need to be welded with 100 percent accuracy at the end of the unit.

D.2 Given proper instruction in welding different metals together, the student will be able to weld two pieces of metal with 90 percent accuracy at the end of the unit.

D.3 Given proper instruction in gas welding and brazing, the student will be able to weld two pieces of metal together by use of gas welding and brazing processes with 90 percent accuracy at the end of the unit.

D.4 Given proper instruction in arc welding processes, the student will be able to weld two pieces of metal using the arc welding processes with 90 percent accuracy.

D.5 Given proper instruction in the use of a magnetic tester, the student will test a few welded pieces using the testing machine with 100 percent accuracy at the end of the unit.

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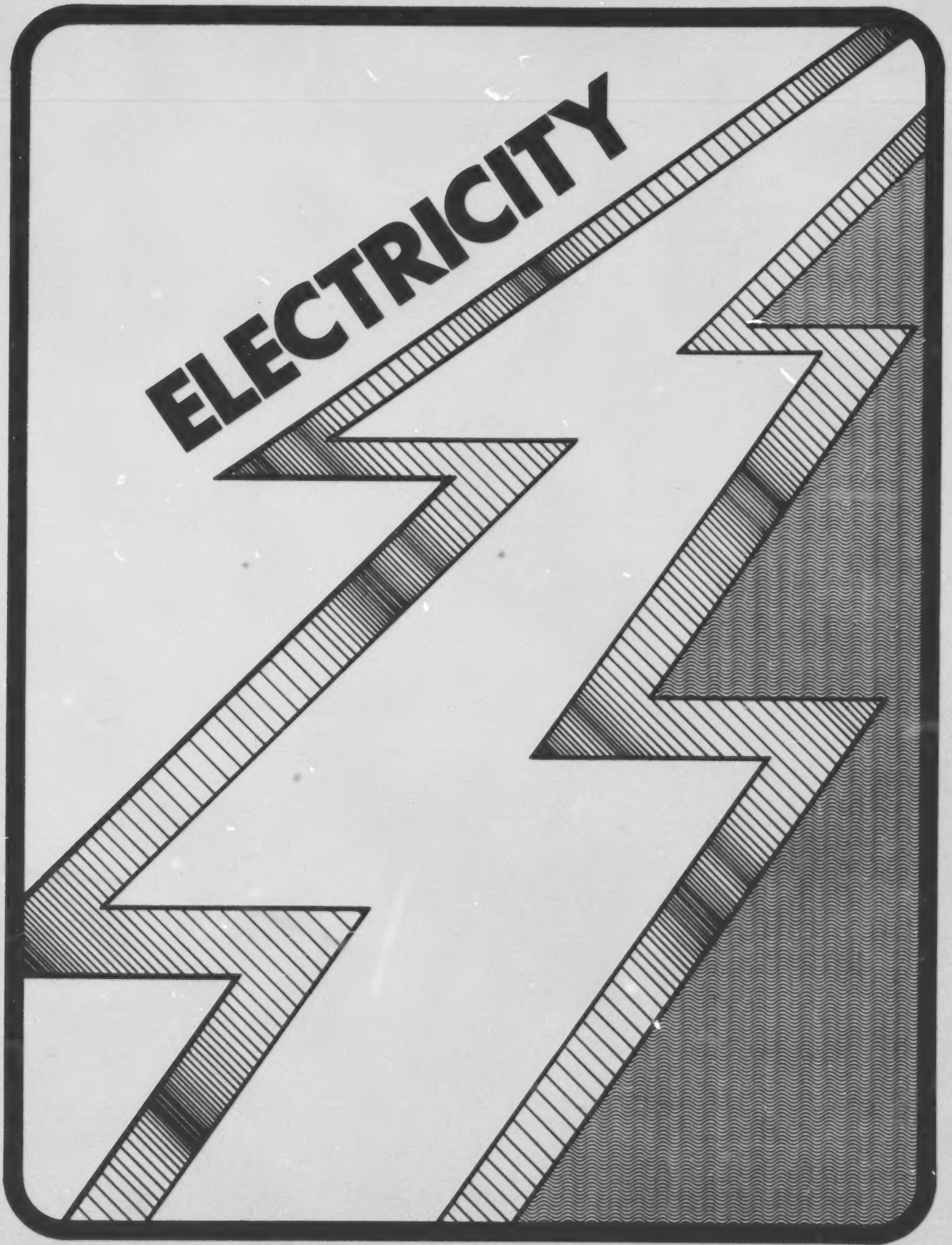
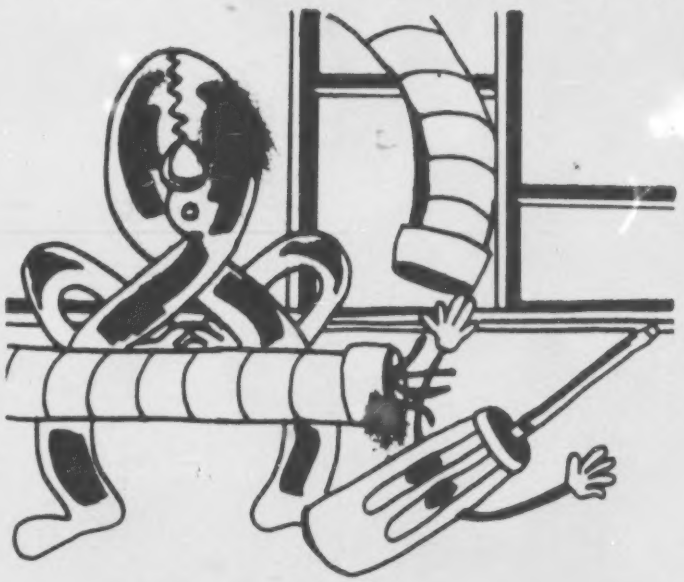

ELECTRICITY

ELECTRICIANS

JOB DESCRIPTION

Electricians are called Construction Electricians if they primarily work on new construction and building projects or Maintenance Electricians if they work in factories or large buildings keeping existing electrical circuits and equipment in working order. Both types of Electricians plan, lay out, assemble, install, test, repair and maintain electric wiring, fixtures, and power and communications equipment. They use numerous power and hand tools and special measuring devices such as ammeters, ohmmeters, voltmeters, and test lamps. They may inspect new electrical installations for conformity to electrical, fire, and safety codes or estimate cost of installation on repair jobs.

The Electrician (DOT NO. 824.281): plans layout and installs and repairs wiring, electrical fixtures, apparatus, and control equipment; plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical code; prepares sketches showing location of all wiring and equipment or follows diagrams or blueprints prepared by others, insuring that concealed wiring is installed before completion of walls, ceilings, and flooring; measures, cuts, bends, threads, assembles, and installs electrical conduit, using such tools as hacksaw, pipe threader, and conduit bender; pulls wiring through conduit, assisted by Electrician Helper; splices wires by stripping insulation from terminal leads with knife or pliers, twisting or soldering wires together, and applying tape or terminal caps; connects wiring to lighting fixtures and power equipment, using hand tools; installs control and distribution apparatus, such as switches, relays, and circuitbreaker panels, fastening them in place with screws or bolts, using drills, masonry chisels, hammer, anchor bolts, and wrench; connects power cables to equipment, such as electric range or motor, and installs grounding leads; tests continuity of circuit to insure electrical compatibility and safety of all components, using standard instruments, such as ohmmeter, battery, and buzzer and oscilloscope; observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacement; may repair faulty equipment or systems (Electrical Repairman); may be required to hold license; may cut and weld steel structural members, using flame-cutting and welding equipment; may be designated according to work location as Mine Electrican (mining and quarrying).



TRAINING AND QUALIFICATIONS

Apprenticeship is the best method of entry. (However, some people become Electricians by working as helpers for several years or through special training when in the Armed Forces.) There are a number of active four-year apprenticeship programs operating in Arizona. Competition for entrance into these programs is keen. Potential apprentices should take high school courses in mathematics (must have algebra and trigonometry), physics, electrical theory and practice, blueprint reading, mechanical drawing, and Building Trades I and II. They should have physical strength and agility, numerical and spatial aptitude, color discrimination, manual and finger dexterity, and good eye-hand coordination.

WAGES

The basic union rate for most journeyman Electricians is currently $9.45 per hour. Apprentice starting wages are 45 percent of the journeyman rate with periodic increases as training progresses. Experienced Maintenance Electricians earn from $4.50 to $6.00 per hour, and may start new employment at about $4.00 to $4.25 per hour.

ADVANCEMENT

Experienced journeymen have opportunities to advance to Foreman and eventually to job Superintendent. A few start their own contracting or repair businesses. Electricians in construction work sometimes consider Electrical Repairman, Powerhouse Electrician, and Mine Electrician as falling from "grace," but these areas generally offer a good deal of job stability.

WHERE EMPLOYED

In 1970, there were nearly 190,000 Construction Electricians and 250,000 Maintenance Electricians employed in the United States. In Arizona, some 4,100 Electricians were employed, with nearly 47 percent of these employed in Maricopa County and about 25 percent in Pima County. Less than 2 percent of all Electricians employed in Arizona in 1970 were women.

EMPLOYMENT OUTLOOK

Between 1973 and 1978, it is anticipated that there will be about 1,790 new jobs for Electricians in Arizona. An estimated 50 percent of these new jobs will be in Maricopa County, with about 29 percent in Pima County.

ELECTRICIANS INSTRUCTIONAL ANALYSIS

A. Identifying house-wiring elements

TASKS	INFORMATION TOPICS
1. Read and study blueprints and specifications	1. Electrical safety
2. Analyze detail drawings on cut sheets	
3. Identify house-wiring components	3. Production and transmission of electricity
4. Obtain tools and equipment needed	
5. Order components and supplies	5. Terminology
6. Examine electrical test equipment to determine if they function properly	

Objectives for identifying house-wiring elements

A.1 The student will read an electrical blueprint and determine what tools and materials are needed to complete the blueprint requirements.

A.2 The student will identify components necessary in wiring a residence with 80 percent accuracy.

A.3 The student will determine tools and equipment needed for the installation of an electrical circuit as specified in the electrical blueprints.

A.4 The student will test branch circuits in a home and see if they correspond to the blueprint specifications.

B. Installing service entrance

TASKS	INFORMATION TOPICS
1. Read blueprints	1. National Electric Code
2. Install load center	
3. Connect main grounding or bonding	3. Grounding and bonding
4. Connect water bond to main water line	
5. Connect other ground to foundation of structure	5. Conductors and general wiring
6. Pull wires and clip to correct length	

7. Prepare ends of wire

8. Install circuit breakers

Objectives for installing service entrance

B.1 The student will determine location of load center, meter mount, and service entrance as specified in plan or area codes.

B.2 The student will follow area codes and blueprint specifications in locating and installing a main service panel.

B.3 The student will hang a standpipe, weatherhead, and meter mount according to area codes and specifications

B.4 The student will determine path, amount, and type of cable needed to complete circuits indicated on the blueprints.

B.5 The student will select type and size circuit breaker needed to service each branch circuit specified in the blueprint.

C. Installing branch circuits

TASKS	INFORMATION TOPICS
1. Read blueprints	1. General Information:
2. Install service boxes for general purpose circuits. Examples: outlet boxes, lighting boxes, and switch boxes.	Before pulling the wire, check how many outlets and/or lights are allowed on each circuit. Make sure the wire size is correct. Most kitchens, dens, and family rooms, need to be #12 cu. and the remaining portion of the house requires #14 cu. Keep all low-voltage wire separate from the high-voltage wire. (door bell wire, speaker wire)
3. Install service boxes for individual circuits. Examples: doorbell, heating/cooling system.	
4. Install service boxes for appliance circuits. Examples: electric range, water heater, dryer.	
5. Install conduit or bore studding, whichever is needed	
6. Pull wire from load center to each circuit	After the wire has been pulled, one must go through the house and make up all the joints; i.e., when two or more wires feed through a box such as a Sw box, the hot wire must be made up and tailed for the switch.

When mounting the boxes, make sure the boxes are big enough to handle all the wires according to NEC.

Objectives for installing branch circuits

C.1 The student will determine path, materials, and equipment needed for locating and installing branch circuits according to blueprints and area codes.

C.2 The student will select tools and materials needed for installing a general purpose circuit as specified in plans.

C.3 The student will select tools and materials needed for installing individual circuits as specified in plans.

C.4 The student will select tools and materials needed for installing appliance circuits as specified in plans.

C.5 The student will install correct type and amount of cable needed to complete each branch circuit found in the blueprints.

D. **Installing fixtures, receptacles and testing**

TASKS	INFORMATION TOPICS
1. Read blueprints	
2. Mount light fixtures	2. Methods of installation
3. Mount outlets	
4. Mount switches	
5. Test service entrance	5. Electrical testing
6. Test meter	
7. Test all branch circuits	
8. Correct any inadequate wiring	

Objectives for installing fixtures, receptacles and testing

D.1 The student will select materials needed for installing fixtures and receptacles in respect to room decor, area codes, and blueprint specifications.

D.2 The student will correctly connect and mount a light fixture according to the instructor's demonstration.

D.3 The student will correctly connect and mount an outlet according to the instructor's demonstration.

D.4 The student will correctly connect and mount a switch according to the instructor's demonstration.

D.5 The student will test a service entrance and see if it complies to wiring specifications.

D.6 The student will test meter to see if it complies to wiring specifications.

D.7 The student will test a branch circuit to see if it complies to wiring specifications.

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APPRENTICESHIP OPPORTUNITIES

Know all men that I, Thomas Millard, with the Consent of Henry Wolcott of Windsor unto whose custody & care at whose charge I was brought over out of England into New England, doe bynd myself as an apprentise for eight yeeres to serve William Pynchon of Springfield, his heires & assigns all manner of lawful employmt unto the full ext of eight yeeres beginninge the 29 day of Sept 1640. & the said William doth condition to find the said Thomas meat drinke & clothing fitting such an apprentise & at the end of his tyme one new sute of apparell & forty shillings in mony: subscribed this 28 October 1640

What it was like to be an apprentice in early New England is indicated by these words from a 1640 indenture. As it turned out, apprentice Millard lost out on the cash mentioned. The following statement is made at the foot of the indenture:

Tho Millard by his owne consent is released & discharged of Mr. Pynchons service this 22. of May 1648 being 4 months before his tyme comes out, in Consideration whereoff he looses the 40s in mony wch should have bin pd him, but Mr. Pynchon giveth him one New sute of Aparell he hath at present

Indentures were forerunners of our modern apprenticeship agreements. Today the apprentice's situation is far different from Thomas Millard's. The apprentice is no longer bound body and soul to a master. He no longer lives in a master's house nor is dependent upon a master for handouts of food, a little clothing, or a few uncertain shillings.

Nowadays, the apprentice is a member of a production force as he trains on the job and in the classroom. He is paid wages, works a regular workweek, and lives in his own home rather than in that of a master. His apprenticeship agreement sets out the work processes in which he is to be trained and the hours and wages for each training period. At the end of his apprenticeship, he receives a certificate that is similar to the diploma awarded the engineering graduates of universities.

As a candidate for apprenticeship, a student will be rated on his potential as a future craftsman, and his school records will be an important consideration. In a sense, apprenticeship is the "university" of the trades, and like a university, qualifications for acceptance are stringent. There is keen competition among candidates, and those who have the highest qualifications will be the first selected for available apprenticeship programs.

Many students who compete successfully for apprenticeships will number among the leaders of tomorrow in the world of construction. Many already have the basic qualifications such

as a high school education and adequate aptitude for a specific trade; however, if they have concentrated on certain shop courses, basic mathematics, and composition, and would like to continue post-high school education, they will have gained an advantageous, competitive position.

Applicants (both young men and women) are evaluated and placed on a waiting list sequentially; therefore, apprenticeships do not represent immediate job possibilities even after the application process has been completed. It is recommended that applicants who are presently working continue to do so; those not employed should seek work to tide them over until they can be indentured (hired) as an apprentice.

The application process varies somewhat from trade to trade, but generally the applicant should complete the following steps:

1. Select the trade or trades he desires to follow throughout his work life.

2. Determine if he meets the minimum qualifications for the trade. (If not, plans should be initiated to acquire such qualifications.)

3. Decide whether he can work under the job conditions of that trade, some of which may be hazardous, dirty, uncomfortable, or otherwise unpleasant.

4. Seek out information regarding improvement of his competitive position from the APPRENTICESHIP INFORMATION CENTER counselors, journeymen, or public libraries.

MINIMUM QUALIFICATIONS FOR APPRENTICES IN THE BUILDING TRADES IN ARIZONA

REQUIREMENTS	BRICKLAYERS AND STONE MASONS	CABINET-MAKERS	CARPENTERS	ELECTRICIANS (INSIDE)	GLAZIERS
MINIMUM AGE	17–27	17–27	17–27	18–24	18–26
EDUCATION	HS OR GED	HS OR GED	HS OR GED	HS – 1 YR. ALGEBRA	HS OR GED PREFERRED
PHYSICAL FITNESS	FOR TRADE	FOR TRADE	FOR TRADE	FOR TRADE	FOR TRADE
PHYSICAL EXAMINATION	WHEN REQ'D	WHEN REQ'D	WHEN REQ'D	AS REQ'D	WHEN REQ'D
APTITUDE TESTS	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED
TRADE TEST	WHEN REQ'D	--	ENTRANCE EXAM	--	--
HIGH SCHOOL TRANSCRIPT	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED
BIRTH CERTIFICATE	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED
*MILITARY DISCHARGE	REQUIRED	REQUIRED	WHEN REQ'D	AS REQ'D	REQUIRED
CITIZENSHIP	OR STMT. OF INTENT	OR STMT. OF INTENT	OR STMT. OF INTENT	OR STMT. OF INTENT	OR STMT. OF INTENT
AGE EXCEPTIONS FOR:					
PREVIOUS EXPERIENCE	YES	--	--	--	YES
UNUSUAL EDUCATION	YES	--	--	--	YES
UNUSUAL QUALIFICATIONS	YES	--	--	--	YES
VETERAN STATUS	PROVIDING HONORABLE DISCHARGE	THROUGH 32	THROUGH 32	YES (MAX. 4 YRS.)	YES
APPRENTICE TERM	3 YEARS	4 YEARS	4 YEARS– CAN GO 5	4 YEARS	3 YEARS
RELATED INSTRUCTION	432 HRS.	576 HRS.	576 HRS.	576 HRS.	432 HRS.
PROBATIONARY PERIOD	4 MONTHS	500 HRS.	3 MONTHS OR 500 HOURS	1 YEAR	500 HRS.
ACCEPT APPLICATIONS	YEAR ROUND	YEAR ROUND	YEAR ROUND	BEFORE 3/1 OF CALEN-DAR YEAR	YEAR ROUND
INDENTURE (HIRING AGREEMENT)	EACH SPRING	AS REQ'D	AS REQ'D	MAY EACH YEAR	AS REQ'D

*IF APPLICABLE

REQUIREMENTS	IRONWORKERS	LATHERS	OPERATING ENGINEERS	PAINTERS & DECORATORS	PLUMBERS & PIPE FITTERS (REFRIG.)
MINIMUM AGE	18–30	18–26	18–30	16–26	18–25
EDUCATION	HS OR GED	HS OR GED	HS OR GED	HS OR GED	HS OR GED
PHYSICAL FITNESS	FOR TRADE	FOR TRADE	FOR TRADE	NOT COLOR BLIND	FOR TRADE
PHYSICAL EXAMINATION	DR.'S CTF.	WHEN REQ'D	--	--	--
APTITUDE TESTS	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED
TRADE TEST	QUESTION-NAIRE	--	REQUIRED	--	REQUIRED
HIGH SCHOOL TRANSCRIPT	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED
BIRTH CERTIFICATE	REQUIRED	REQUIRED	AS REQ'D	REQUIRED	REQUIRED
*MILITARY DISCHARGE	--	REQUIRED	AS REQ'D	REQUIRED	--
CITIZENSHIP	OR STMT. OF INTENT	OR STMT. OF INTENT	OR STMT. OF INTENT	OR STMT. OF INTENT	OR STMT. OF INTENT
AGE EXCEPTIONS FOR:					
PREVIOUS EXPERIENCE	--	YES	AFTER PROBATION	YES	
UNUSUAL EDUCATION	--	YES	YES	YES	
UNUSUAL QUALIFICATIONS	YES	YES	YES	YES	
VETERAN STATUS	YES	YES	YES	YES	
APPRENTICE TERM	3 YEARS	3 YEARS	3 YEARS	3 YEARS	5 YEARS
RELATED INSTRUCTION	432 HRS.	432 HRS.	576 HRS.	432 HRS.	1100 HRS.
PROBATIONARY PERIOD	4 MONTHS	4 MONTHS	6 MONTHS	3 MONTHS	NOT LESS THAN 3 MO. NOT MORE THAN 9 MO.
ACCEPT APPLICATIONS	1:00–4:30 1ST THRU 4TH MONDAY APR. & OCT.	2ND TUES. EACH MONTH	FRIDAY ONLY YEAR ROUND	A.M. WED. ONLY YEAR ROUND	YEAR ROUND
INDENTURE (HIRING AGREEMENT)	AS REQ'D	AS REQ'D	AS REQ'D	AS REQ'D	AS REQ'D

*IF APPLICABLE

REQUIREMENTS	CEMENT MASONS AND PLASTERERS	POWER LINEMEN (OUTSIDE)	SHEET METAL WORKERS	TILE SETTERS
MINIMUM AGE	18–25	18–25	17–27	17–25
EDUCATION	HS OR GED	HS	HS OR GED	HS OR GED
PHYSICAL FITNESS	FOR TRADE	FOR TRADE	FOR TRADE	FOR TRADE
PHYSICAL EXAMINATION	WHEN REQ'D	--	WHEN REQ'D	--
APTITUDE TESTS	REQUIRED	REQUIRED	REQUIRED	REQUIRED
TRADE TEST	--	--	--	--
HIGH SCHOOL TRANSCRIPT	REQUIRED	REQUIRED	REQUIRED	REQUIRED
BIRTH CERTIFICATE	REQUIRED	AS REQ'D	REQUIRED	--
*MILITARY DISCHARGE	--	AS REQ'D	AS REQ'D	REQUIRED
CITIZENSHIP	OR STMT. OF INTENT	OR STMT. OF INTENT	OR STMT. OF INTENT	OR STMT. OF INTENT
AGE EXCEPTIONS FOR:				
PREVIOUS EXPERIENCE	YES	YES	YES	YES
UNUSUAL EDUCATION	YES	--	--	YES
UNUSUAL QUALIFICATIONS	YES	--	YES	YES
VETERAN STATUS	YES	YES	YES	YES
APPRENTICE TERM	3 YR–CEMENT 4 YR–PLAST.	4 YEARS	4 YEARS	3 YEARS
RELATED INSTRUCTION	432 CEMENT 576 PLAST.	576 HOURS MINIMUM	580 HOURS	432 HOURS
PROBATIONARY PERIOD	4 MONTHS	500 HOURS	500 HOURS	500 HOURS
ACCEPT APPLICATIONS	YEAR ROUND	YEAR ROUND MUST COMPLETE BEFORE 11/1	MAY ONLY	YEAR ROUND
INDENTURE (HIRING AGREEMENT)	AS REQ'D	DECEMBER	AS REQ'D	AS REQ'D

*IF APPLICABLE

QUESTIONS AND ANSWERS ON APPRENTICESHIP IN THE BUILDING TRADES

Q *What, exactly, is an apprentice?*

A An *apprentice* is a trainee in any skilled craft. You are enrolled in an *apprenticeship* program that combines progressive on-the-job training with related classroom instruction. In such a program you start to earn, learn, and work at the same time. At the completion of the training period you are a skilled worker, a *journeyman.*

Q *What is the difference between apprenticeship training and other on-the-job training?*

A Apprenticeship is based on a *formal* written agreement with your employer stating the conditions of your training period: length of time, amount of pay, and rate of periodic increases, with *certification* as a journeyman on completion of the term. You will be qualified as a skilled craftsman and so recognized throughout the industry, wherever you may go, for you will have learned your craft according to that industry's standards.

Q *How long is the training period?*

A It varies with the occupation, but ranges generally from 3 to 5 years. Classroom instruction, given in a local vocational school or by an instructor in other facilities is usually 144 hours a year.

Q *Isn't it possible to learn a trade without going through so many years of required training?*

A You can learn some aspects of a trade without being enrolled in an apprenticeship program, but the most effective way to become a *skilled* craftsman (journeyman) is through apprenticeship training. There is a big difference in pay and career outlook when you go through this training and learn by progressive steps the right way to work. Then you are no longer unskilled; you are a competent, certified craftsman who can instruct others while holding down a good job. You will have a thorough knowledge of your entire craft, not just of a part of it—as most semiskilled workers do.

Q *How much will I earn as an apprentice?*

A You will start at about half the wage paid the skilled worker (journeyman) in the building trades. This differs from trade to trade and according to geographic location, but it is usually considerably higher than the wage paid the unskilled or semiskilled worker. You will normally receive a pay raise every six months, and during the last half-year of your training you will be receiving at least 90 percent of the journeyman's basic wage, with 100 percent of that wage being paid you on completion of training. You will also be entitled to other benefits furnished by your employer, such as sick leave, paid vacations and holidays, and workmen's compensation.

Q *Can a young woman become an apprentice in the building trades?*

A Of the 3,613 apprentices now working in Arizona's many construction unions, only six are women (one carpenter and five drywall tapers). There hasn't been any direct effort made until recently to get women in construction, but that is changing. Historically, construction has been known as a man's field symbolized by a big burly figure in a hard hat; however, lately there have been some women in hard hats. Today, if you want to earn equal pay, the opportunities are better than ever before.

Q *Are jobs always available for skilled workers?*

A Almost all apprenticeship programs have long waiting lists, and this may run as high as ten applicants for every opening. Construction jobs are tight right now in context of the national economy, but looking ahead, Arizona is expected to continue its construction boom, not just in housing but in all areas.

Q *How do I know if I would make a good apprentice in the building trades?*

A A variety of abilities, aptitudes, and personal qualities are looked for when choosing apprentices. No one person is expected to have all of them. They are just clues to placing the right person in the right job!

- Do you have a high school or vocational school education?
  Perhaps you studied math, science?
  or took industrial arts or vocational courses?
  or liked drawing or other creative activities?

- Is your health good?

- Do you have good coordination of hands and eyes?
  ability to recognize and match various forms?
  finger dexterity?
  a good memory?
  a talent for solving problems?

- Are you ambitious?
  Will you stay on the job until it is done and learn all you can? Apprenticeship training in the building trades is not a temporary, short term job. it is the basis of a fine career for life. It is hard work, exacting work, rewarding work.

Q *Where can I get additional information?*

A Bureau of Apprenticeship and Training
Manpower Administration
U.S. Department of Labor
Washington, DC 20210

Apprenticeship Information Center
207 East McDowell Road
Phoenix, AZ 85004

EQUIPMENT LISTS

TOOLS AND EQUIPMENT FOR BUILDING TRADES I

CARPENTRY

CEMENT MASONS

		Number Required
1.	Concrete mixer (2–5 cubic foot capacity)	1
2.	Steel trowel	3
3.	Wood float	2
4.	Magnesium float (air-entrained)	2
5.	Groover	1
6.	Edger	1
7.	Transit level	1
8.	Shovel	3
9.	Pick	1
10.	Crowbar	1
11.	Jitterbug tamper (optional)	1
12.	Bull float (optional)	1
13.	Posthole digger	1
14.	Bolt cutter	1
15.	Finishing broom	1

CARPENTERS

		Number Required
	STATIONARY POWER TOOLS	
1.	Grinder, pedestal, 7" 1/2 hp motor, 1725 RPM, shields and grinding attachment, 2 wheels	1
2.	Jointer, wood 8", 1 hp motor	1
3.	Planer, thickness, 12" x 4" capacity 3 hp motor (optional)	1
4.	Saw, circular, 10", tilting arbor, 3/4" dia. arbor, 2 hp motor, with accessories and safety attachments	1

CARPENTERS (Continued)		Number Required
10.	Chisels, wood, set of 1/4", 3/8", 1/2", 5/8" 3/4", 7/8", 1", 1 1/4", 1 1/2", 2"	2 sets
11.	Clamps, "C", set; 10–4" capacity, 6–6" capacity, 4–10" capacity	1
12.	Clamps, "I" bar, various sizes from 2' opening to 6'	16
13.	Countersink, rose head, brace 3/4"	2
14.	Countersink, power tool 82° angle taper	3
15.	Doweling jig	1
16.	Gauge, marking	1
17.	Gauge, depth, auger bit	1
18.	Gauge, mortizing	1
19.	Glass cutter	6
20.	Goggles, safety, clear lens	20
21.	Hammers, claw 16 oz.	15
	20 oz.	5
22.	Knives, putty	3
23.	Spirit level, 5'	1
24.	Level, aluminum, 24"	2
25.	Mallets, rubber head, 2 sizes	2
26.	Protective face shields, clear plastic	6
27.	Plane, rabbet, Stanley #78 or equivalent	1
28.	Plane, router, hand, Stanley #71 or equivalent	3
29.	Plane, block, adjustable, 6"	3
30.	Plane, jack 14"	3
31.	Plane, smooth	3
32.	Plane, jointer	1
33.	Pliers, combination, 6"	6

CARPENTERS (Continued)		Number Required
5.	Saw, radial arm, 10", 5/6 arbor, with miter, bevel, and cutoff scales	1
6.	Drill press 15", 1/2" key chuck, floor model, 1/2 hp motor, with mortising attachments (optional)	1
	PORTABLE POWER TOOLS	
1.	Drill, electric, 1/4" heavy duty	1
2.	Drill, electric, 1/2" heavy duty	1
3.	Router, 7/8 hp motor, 1/4" chuck set of 12 bits and accessories for dove-tail	1
4.	Sander, belt, 3" x 27" (belt size)	1
5.	Sander, orbital-finisning	1
6.	Plane, electric	1
7.	Saw, portable circular, 7" blade, heavy duty	2
8.	Saw, saber with blades, heavy duty	1
9.	Spray gun, quart cup, syphon type, air regulator and compressor necessary for operation	1
10.	Extension cords (50 and 100 ft.)	6
	HAND TOOLS	
1.	Awls, scratch	6
2.	Bevels, sliding "T", 6" nickel plated	2
3.	Bevels, sliding "T", 12" nickel plated	1
4.	Bits, auger, set 1/4" to 1" by 16ths	1
5.	Bit, expansive, range 7/8" to 3"	1
6.	Bits, spade type, set 1/4" shank, 3/8" to 1 1/8"	1
7.	Bit, brace, 10" ratchet	3
8.	Calipers, 8" outside	1
9.	Calipers, 8" inside	1

CARPENTERS (Continued)		Number Required
34.	Pliers, long nose, 6"	3
35.	Pneumatic nail driver	1
36.	Pliers, ball type, notched blade for wire stripping, 5 1/2" long, oblique cutters	6
37.	Pliers, groove joint, 10"	1
38.	Pliers, diagonal cutting, 6"	2
39.	Pliers, side cutting, 6" long (lineman's)	4
40.	Chalk and line box	3
41.	Saw set, for cross and circular saw blades	1
42.	Saw set, for back and panel saws	1
43.	Saw, compass, 12"	1
44.	Saw, back 12", 14 point	2
45.	Saw, cross cut, 8 point	4
46.	Saw, cross cut, 10 point	2
47.	Saw, rip cut, 5 1/2 point	2
48.	Scrapers, cabinet, hook style	2
49.	Scrapers, cabinet 3" x 6"	2
50.	Scrapers, cabinet, Stanley #80m or equivalent	2
51.	Screwdriver, spiral ratchet, Stanley #130a or equivalent	2
52.	Screwdriver, set of 8, assorted sizes	1
53.	Screwdriver, Phillips head, size 2 and 3	2 each
54.	Screwdriver, stubby	1
55.	Squares, framing, 24" x 16"	6
56.	Squares, combination, 12"	10
57.	Stones, slip	2
58.	Vise, saw	1

CARPENTERS (Continued)		Number Required
59.	Wrecking bar	3
60.	10' pocket steel tape rule	20
61.	50' steel tape	1
62.	100' steel tape	1
63.	Folding rule, 72"	3
64.	Nail sets	6
65.	Divider, spring	2
66.	Utility knife	2
67.	Line, builder, nylon, 1000'	1
68.	File, half-round, 10" double cut, bastard	2
69.	Ladder 10'	1
70.	Ladder 8'	1
71.	Scaffold, base section, 4' upper section, complete with braces and brackets, tubular steel	1
72.	Nail puller	1
73.	Saw horses, wood	8
74.	Hinge template	1
75.	Mitre box	1
76.	Sledge, 3 lb.	1
77.	Shingling hatchet	2

MASONRY

BRICKLAYERS		Number Required
	EQUIPMENT	
1.	Mortar box, 15 cu. ft., 82" x 34"	1
2.	Mortar boards, 30" x 30", with stands	5

BRICKLAYERS (Continued)		Number Required
3.	Wheelbarrow, heavy duty	2
4.	Shovel, square point, long handle #2	4
5.	Brick tongs	2
6.	Water barrel, 50 gal., open one end	1
7.	Buckets, 2 gal.	2
8.	Line blocks	10
	TOOLS	
1.	Brick trowel, 12"	4
2.	Mason level, 48"	4
3.	Brick hammer, 12 oz.	2
4.	Bricklayer's set, 3" wide blade	2
5.	Bricklayer's brush, 13"	2
6.	Convex "S" Jointer, 5/8" x 3/4"	1
7.	Half-round sledrunner jointer, 14" x 5/8"	1
8.	Sledrunner jointer, 14" "V"	1
9.	Modular spacing rule, 6'	1

PLUMBING

PLUMBERS AND PIPE FITTERS		Number Required
1.	Pipecutter, wheel type, 4 in. capacity	1
2.	Pipe reamer	1
3.	Power hacksaw (optional)	1
4.	Pipe vise	1
5.	Pipe wrench, 10", 18"	2
6.	Pipe threader and pipe dies, 1/2" to 2"	1
7.	Pipe cutter (portable)	1

PLUMBERS AND PIPE FITTERS (Continued)		Number Required
8.	Electric soldering iron	1
9.	Soldering copper	1
10.	Propane torch	1
11.	Blow torch	1
12.	Gasoline furnace	1
13.	Chanel locks	4 pair
14.	Level, 10–12"	2

WELDERS		Number Required
	ARC WELDING	
1.	Arc welding machine (portable)	1
2.	Motor generator, DC	1
3.	Transformer, AC	1
4.	Rectifier, AC–DC	1
5.	Electrode cable	1
6.	Electrode holder	1
7.	Ground cable	1
8.	Ground clamp	1
9.	Terminal lugs	2
10.	Chipping hammer	1
11.	Wire brush	1
12.	Apron	1
13.	Gloves	2
14.	Flash goggles	1
15.	Safety goggles	1

WELDERS (Continued)		Number Required
16.	Helmet	1
	OXYACETYLENE WELDING	
1.	Acetylene tank	1
2.	Oxygen tank	1
3.	Cart (gas bottle)	1
4.	Acetylene hose	1
5.	Oxygen hose	1
6.	Regulator set	1
7.	Welding torch with tips	1
8.	Cutting torch with tips	1
9.	Lighter	1
10.	Tip cleaner	2 set
11.	Asbestos gloves	1 pair
12.	Welding goggles	1
13.	Soapstone marking pencils	12
13.	C clamps, deep throat	6
14.	Vise grip pliers	2 pair
15.	Cold chisel, 1/2, 5/8, 3/4	3
16.	Metal files, assorted	6
17.	Ball pein hammer, 24 oz.	1

ELECTRICITY

ELECTRICIANS		Number Required
1.	Slip joint pliers	1
2.	Lineman's pliers	2
3.	Side cutting pliers	1

ELECTRICIANS (Continued)		Number Required
4.	Diagonal cutting	1
5.	High leverage and cutting pliers	1
6.	Oblique cutting pliers	2
7.	Hacksaw	2
8.	Soldering gun	1
9.	Multipurpose tool	2
10.	Steel fish tape	1
11.	Conduit bender	1

PROJECT

TYPICAL PROJECT FOR ROLLING HILLS HIGH SCHOOL

Building Trades I Class

SUPERINTENDENT
Fred Siebert

FOREMAN
Andrew Solvesky

CONSULTANT
Lee Perrill

SAFETY ENGINEER
Roy Long

CHIEF CARPENTER
Ted Tafoya

CHIEF DRAFTSMAN
Bill Shaw

CHIEF PLUMBER
Eugene Hamilton

CHIEF ELECTRICIAN
Fin Bayless

CHIEF MASON
Art Newman

CHIEF PAINTER
Tom Denny

TOOL CHECKER
Russ Markwald

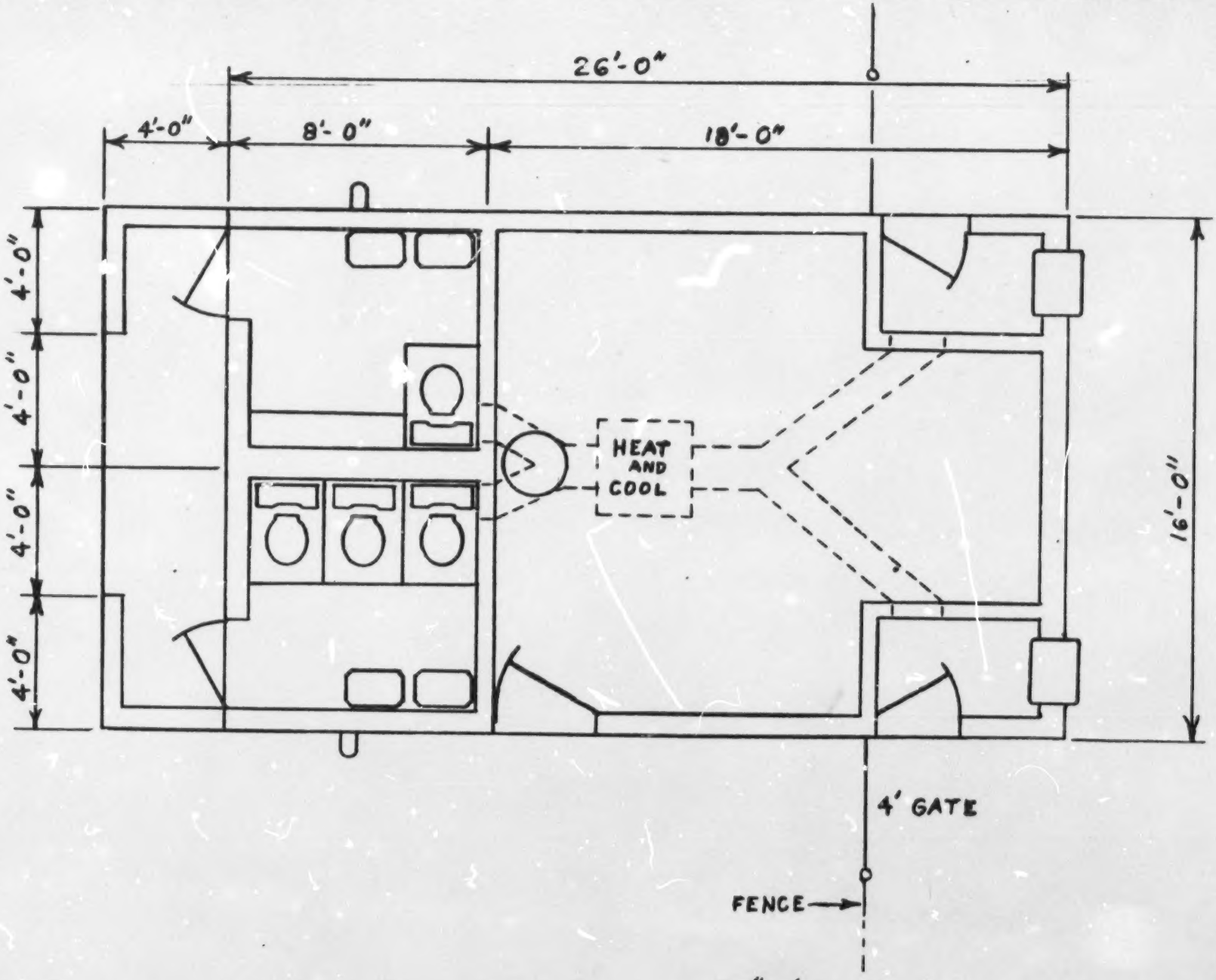
CRAFTSMAN
Ronnie Weatherford
Walt Brubaker

ROLLING HILLS HIGH SCHOOL

Building Trades I Class

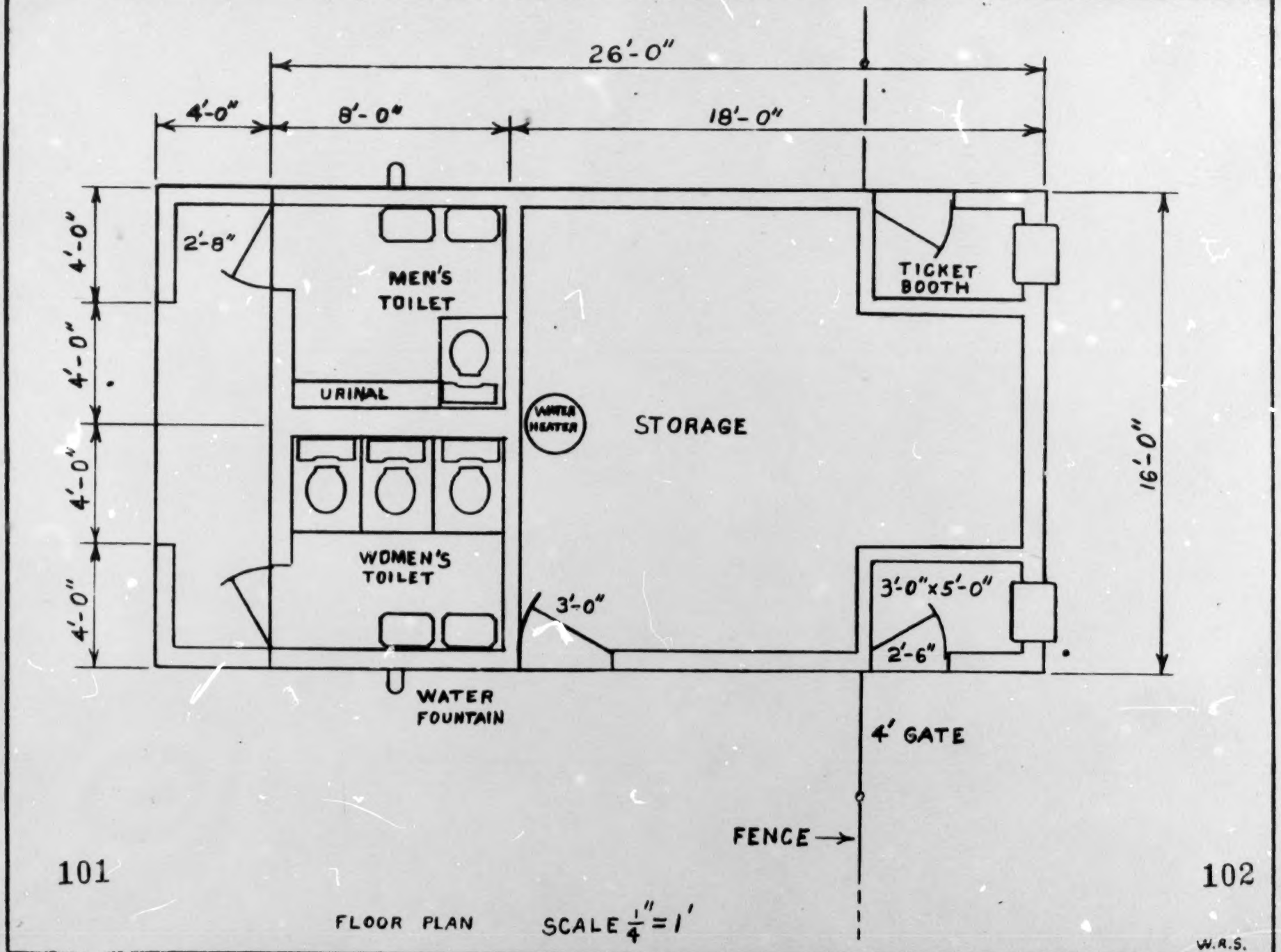
Building Estimate
for
Ticket Booths w/Restrooms and Storage

Foundation, Stem and Floor	$ 166.50
Walls, Exterior and Interior	1,237.71
Roof	669.00
Ceiling	20.00
Windows	40.00
Doors	500.00
Plumbing	845.00
Heating and Air Conditioning	150.00
Electrical	272.11
Landscaping	35.00
Finishing and Painting	100.00
Other	40.00
TOTAL COST	$4,075.32



HEATING & COOLING SCALE $\frac{1}{4}$" = 1'

W.R.S.

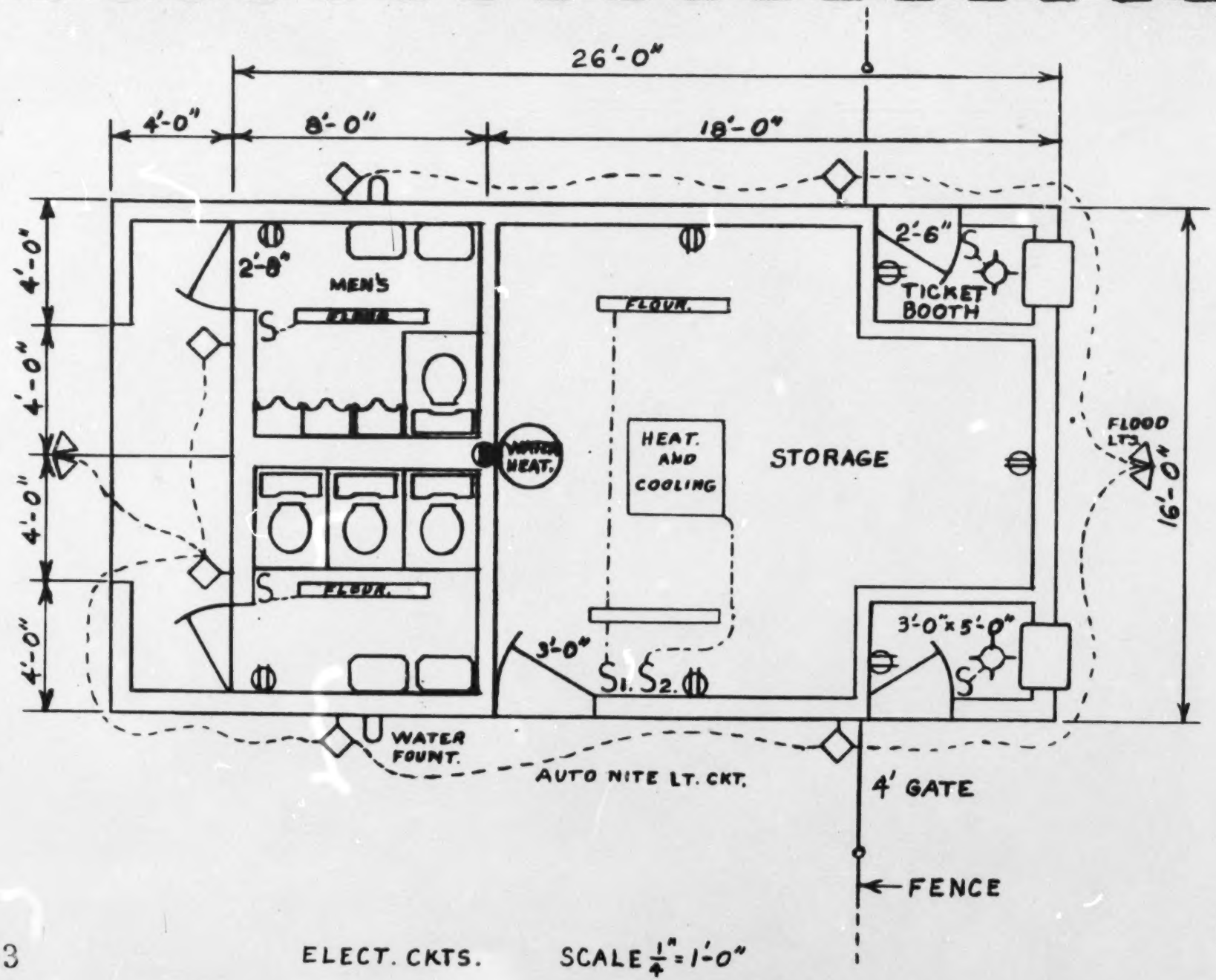


101

102

FLOOR PLAN SCALE $\frac{1}{4}$" = 1'

W.R.S.

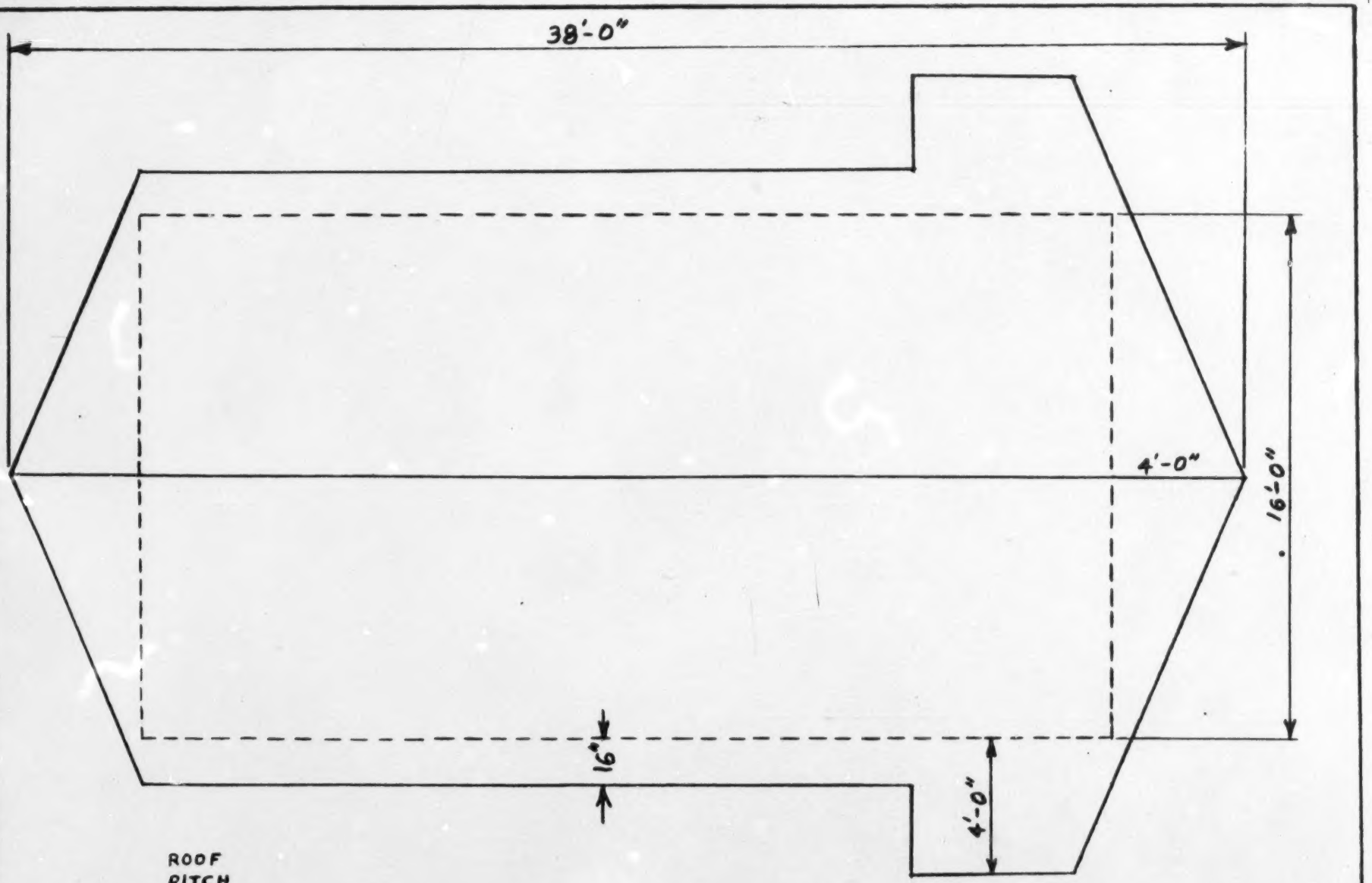


103

ELECT. CKTS. SCALE $\frac{1}{4}$" = 1'-0"

104

W.R.S.



105

106

SCALE $\frac{1}{4}$" = 1'-0"

W.R.S.